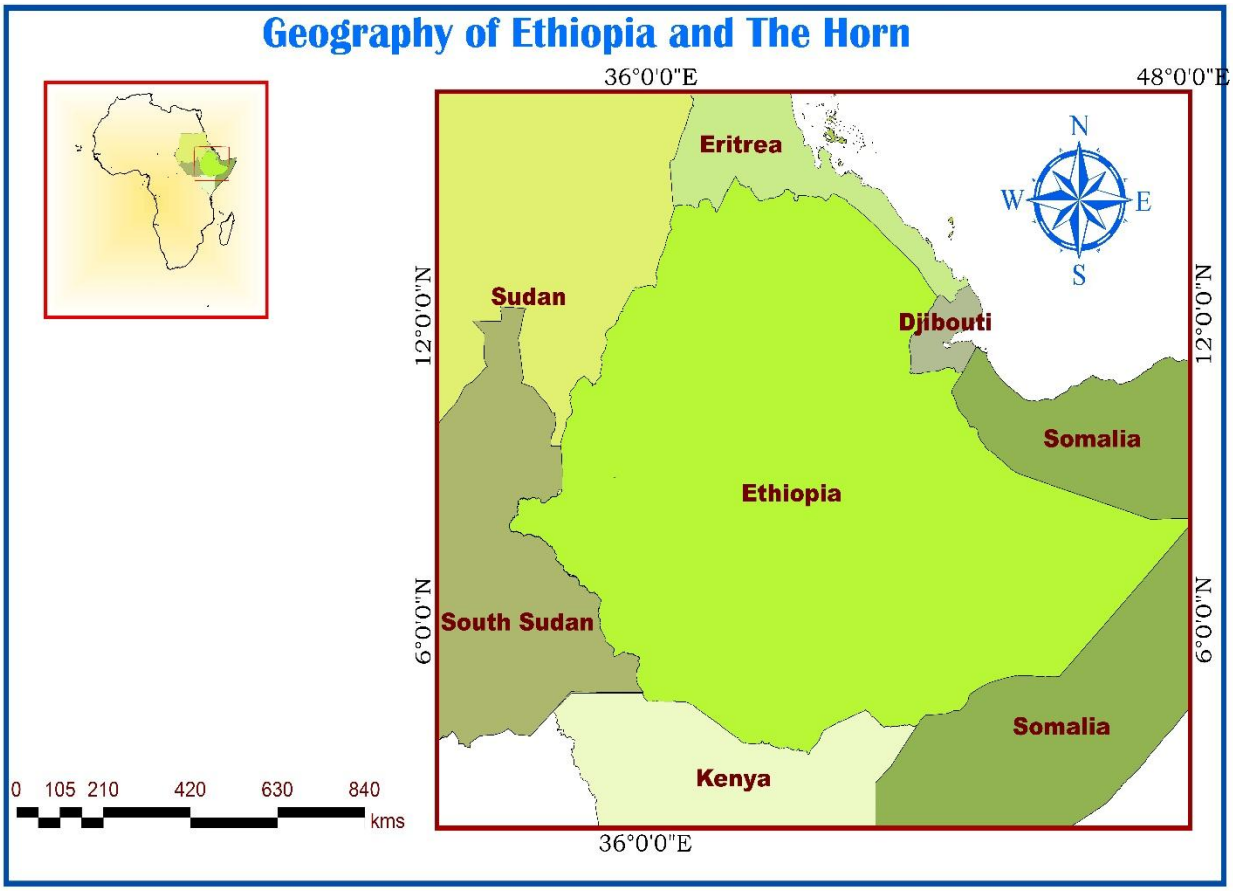

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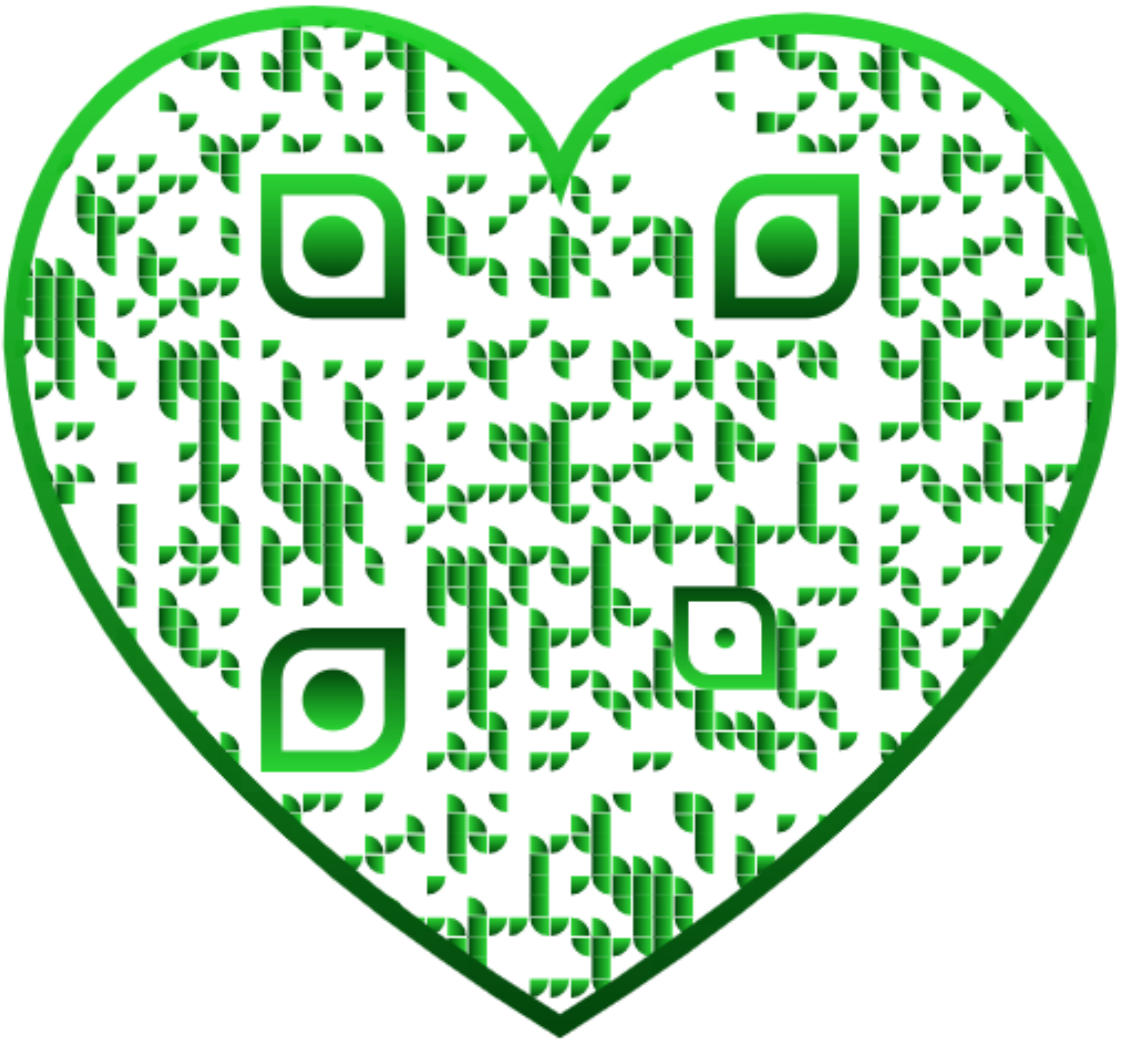

PREFACE

The course Geography of Ethiopia had been offered to all freshman students of Ethiopian Universities until 2005. However, it was interrupted with the curricula revision that ended up making the duration of study for a University degree for most disciplines to be three years. This trend continued for more than a decade and a half. In response to the changing national and global dynamism, the Ministry of Science and Higher Education (MoSHE) had conducted assessment for a curriculum revision. The assessment included gathering evidence from international experiences and domestic practices in proposing courses for the freshman program. The results of the assessment revealed that the Ethiopian education curriculum had not properly addressed national unity among graduates, critical thinking, important non-cognitive skills, employability skills, communication skills, global outlook, and digital literacy to cite few. One of the recommendations of the curriculum revision team was that the curriculum/program need to have components that highlight the necessities of Ethiopian Geography, society, cultures as well as the dynamic interrelationship of people and natural environments over time. As a result, to fill the existing gaps, common courses such as the Geography of Ethiopia and the Horn and others were identified to be offered for all first year students of higher education institutions.

The Geography of Ethiopia and the Horn is, therefore, intended to familiarize students with the basic geographic concepts particularly in relation to Ethiopia and the Horn of Africa. It is also meant to provide students a sense of place and time (geographic literacy) that are pivotal in producing knowledgeable and competent citizens who are able to comprehend and analyze spatial problems and contribute to their solutions. To be geographically illiterate is to deny oneself not only the ability to comprehend spatial problems but also the opportunity to contribute meaningfully to the development of policies for dealing with them. As such, the course provides an opportunity for the reader to understand the implications of the location, shape and size of Ethiopia, as well as the country's physical and human resources diversity and abundance on its socioeconomic development.

The course consists of four parts. The first part provides a brief description on the location, shape and size of Ethiopia as well as basic skills of reading maps. Part two introduces the physical background and natural resource endowment of Ethiopia and the Horn which includes its geology and mineral resources, topography, climate, drainage and water resources, soil, fauna and flora. The third part of the course focuses on the demographic characteristics of the

country and its implications on economic development. The fourth component of the course offers treatment of the various economic activities of Ethiopia and the Horn which include agriculture, manufacturing and the service sectors. Moreover, Ethiopia in a globalizing world is treated in the perspectives of the pros and cons of globalization on its natural resources, population and socio-economic conditions.

This teaching material is compiled to meet the urgent needs of freshman students of Ethiopian Universities, who take the course "Geography of Ethiopia and the Horn (GeES 1011)". It is our fervent belief that the material could also be an important reference for the course instructors as well. Nonetheless, readers of this material are requested to be considerate of the urgency of the material preparation, paucity of data for the very dynamic geography components, as well as the problems of changing boundaries and sizes of the spatial units. At times, reference was made to former administrative units. To the level best possible, however, attempt was made to include the most recent data on the diverse geographic attributes to produce a viable document. We would also like to acknowledge that much more remains to be done in terms of editing and using the most up-to-date data.

The writers are grateful to the Department of Geography and Environmental Studies of Addis Ababa University for providing the basic reference that was substantially used in the write-up of this material. We would like to thank the Ministry of Science and Higher Education for bringing back the Geography of Ethiopia as a freshman course with the intention of nurturing citizens who are zealous and enthusiastic to their country's natural and cultural geographic endowments; and for facilitating the development of the material.

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CHAPTER ONE
INTRODUCTION

1.1. Geography: Definition, Scope and Themes

This chapter deals with the meaning, scope, themes and approaches of Geography. In addition, it discusses the location, shape, and size of Ethiopia and the Horn. It also introduces the tenets of basic map reading skills. Hence, this introductory part of the text paves the way for an understanding of the geographic issues presented in the succeeding chapters.

Objectives

At the end of this chapter, the learners will be able to:

- *Comprehend the meaning and scope of Geography.*
- *Explain the themes of Geography.*
- *Explicate the implications of location, shape and size of Ethiopia and the Horn on the physical environment, socioeconomic and political aspects.*
- *Acquire basic skills of map reading.*

1.1.1. Meaning of Geography

Activity 1.1

1. Define Geography.

2. Could you mention the major themes of Geography?

3. Do you know where the Horn of Africa is located? What are the member states of the Horn of Africa?

4. Distinguish between astronomical and relative locations?

It is difficult to forward a definition acceptable to all geographers at all times and places because of the dynamic nature of the discipline and the changes in its scope and method of study. However, the following may be accepted as a working definition.

Geography is the scientific study of the Earth that describes and analyses spatial and temporal variations of physical, biological and human phenomena, and their interrelationships and dynamism over the surface of the Earth.

1.1.2. The Scope, Approaches and Themes of Geography

Geography has now acquired the status of science that explains the arrangements of various natural and cultural features on the Earth surface. Geography is a holistic and interdisciplinary field of study contributing to the understanding of the changing spatial structures from the past to the future. Thus, the scope of Geography is the surface of the Earth, which is the very thin zone that is the interface of the atmosphere, lithosphere, hydrosphere and biosphere, which provides the habitable zone in which humans are able to live.

Geography can be approached by considering two continuums: a human-physical continuum and a topical-regional continuum. The topical (systematic) fields of Geography view particular categories of physical or human phenomena as distributed over the Earth while regional geography is concerned with the associations within regions of all or some of the elements and their interrelationships.

Geography has five basic themes namely location, place, human-environment interaction, movement, and region.

Location

Location is defined as a particular place or position. Most studies of geography begin with the mention of this theme of geography. Location can be of two types: absolute location and relative location. In the former case, the location of a place is defined by its latitude and longitude or its exact address.

Place

Place refers to the physical and human aspects of a location. This theme of geography is associated with toponym (the name of a place), site (the description of the features of the place), and situation (the environmental conditions of the place). Each place in the world has its unique characteristics expressed in terms of landforms, hydrology, biogeography, pedology, characteristics and size of its human population, and the distinct human cultures. The concept of "place" aids geographers to compare and contrast two places on Earth.

Human-Environment Interaction

Humans have always been on ceaseless interaction with their natural environment. No other species that has lived on our planet has a profound effect on the environment as humans. Humans have adapted to the environment in ways that have allowed them to dominate all other species on Earth. Thus, human-environment interaction involves three distinct aspects: dependency, adaptation, and modification. Dependency refers to the ways in which humans are dependent on nature for a living. Adaptation relates to how humans modify themselves, their lifestyles and their behavior to live in a new environment with new challenges. Modification allowed humans to "conquer" the world for their comfortable living.

Movement

Movement entails to the translocation of human beings, their goods, and their ideas from one end of the planet to another. The physical movement of people allowed the human race to inhabit all the continents and islands of the world. Another aspect of movement is the transport of goods from one place on the Earth to another. The third dimension of movement is the flow of ideas that allows the unification of the human civilization and promotes its growth and prosperity.

Region

A region is a geographic area having distinctive characteristics that distinguishes itself from adjacent unit(s) of space. It could be a formal region that is characterized by homogeneity in terms of a certain phenomenon (soil, temperature, rainfall, or other cultural elements like language, religion, and economy). It can also be a functional or nodal region characterized by functional interrelationships in a spatial system defined by the linkages binding particular phenomena.

1.2. Location, Shape and Size of Ethiopia and the Horn

The Horn of Africa, a region of eastern Africa, is a narrow tip that protrudes into the northern Indian Ocean, separating it from the Gulf of Aden. It is the easternmost extension of African land defined as the region that is home to the countries of Djibouti, Eritrea, Ethiopia, and Somalia, whose cultures have been linked throughout their long history. Although the countries of the region share many common features, there is also great diversity among them, rendering each country unique in many respects. In terms of size, Ethiopia is the largest of all the Horn of African countries, while Djibouti is the smallest.

The Horn contains such diverse areas as the highlands of the Ethiopian Plateau, the Ogaden desert, and the Eritrean and Somali coasts. Its coasts are washed by the Red Sea, the Gulf of Aden, and the Indian Ocean, and it has long been in contact with the Arabian Peninsula and southwestern Asia.

1.2.1. Location of Ethiopia

The location of a country or a place on a map or a globe is expressed in two different ways. These are astronomical and relative locations (Figure 1.1).

Astronomical location, also known as absolute or mathematical location, states location of places using the lines of latitudes and longitudes. Astronomically, Ethiopia is a landlocked country located between 3^oN (Moyale) and 15^oN (Bademe - the northernmost tip of Tigray) latitudes and 33^oE (Akobo) to 48^oE (the tip of Ogaden in the east) longitudes. The east west distance (15^0) is longer than the north-south distance (12^0). The latitudinal and longitudinal extensions are important in two ways. First, as a result of its latitudinal extension the country experiences tropical climate and secondly due to its longitudinal extension there is a difference of one hour between the most easterly and most westerly points of the country. It is only for convenience that the 3 hours-time zone is used in all parts of the country.

Relative location expresses the location of countries or places with reference to the location of other countries (vicinal), landmasses or water bodies. The relative location of Ethiopia is indicated in Table 1.1.

Table 1.1: The relative location of Ethiopia

Vicinal location	In relation to water bodies & land masses
➲ Sudan to the west and northwest ➲ South Sudan to southwest ➲ Djibouti to the east ➲ Somalia to the east and southeast ➲ Eritrea to the north and northeast	➲ In the Horn of Africa ➲ Southwest of the Arabian Peninsula ➲ South of Europe ➲ Northwest of the Indian Ocean ➲ In the Nile Basin

➲ Kenya to the south	

The implications of the location of Ethiopia are described as follows:

a) **Climate**: The fact that Ethiopia is located between 3^0N and 15^0N (between the Equator and Tropic of Cancer) implies that the country has a tropical climate, though modified by its altitude. The location of Ethiopia relative to the Indian Ocean, the Atlantic Ocean and the African and Asian landmass has also various bearings on the climate of Ethiopia.

b) **Socio-cultural**: Ethiopia is one of the earliest recipients of the major world religions namely Christianity, Islam and Judaism due to its proximity to the Middle East, which was the origin of these religions. The linguistic and other cultural relationships, which Ethiopia shares with its neighbours, reflect the influence of location.

c) **Political:** The political history of Ethiopia has been considerably influenced by:
   - Geopolitical considerations of superpowers.
   - Adjacency to the Red Sea (a major global trade route).
   - The Middle East geopolitical paradigms.

As a result, Ethiopia has been exposed for external invasions in a number of times; though the country resisted foreign intervention and remains free of external domination.

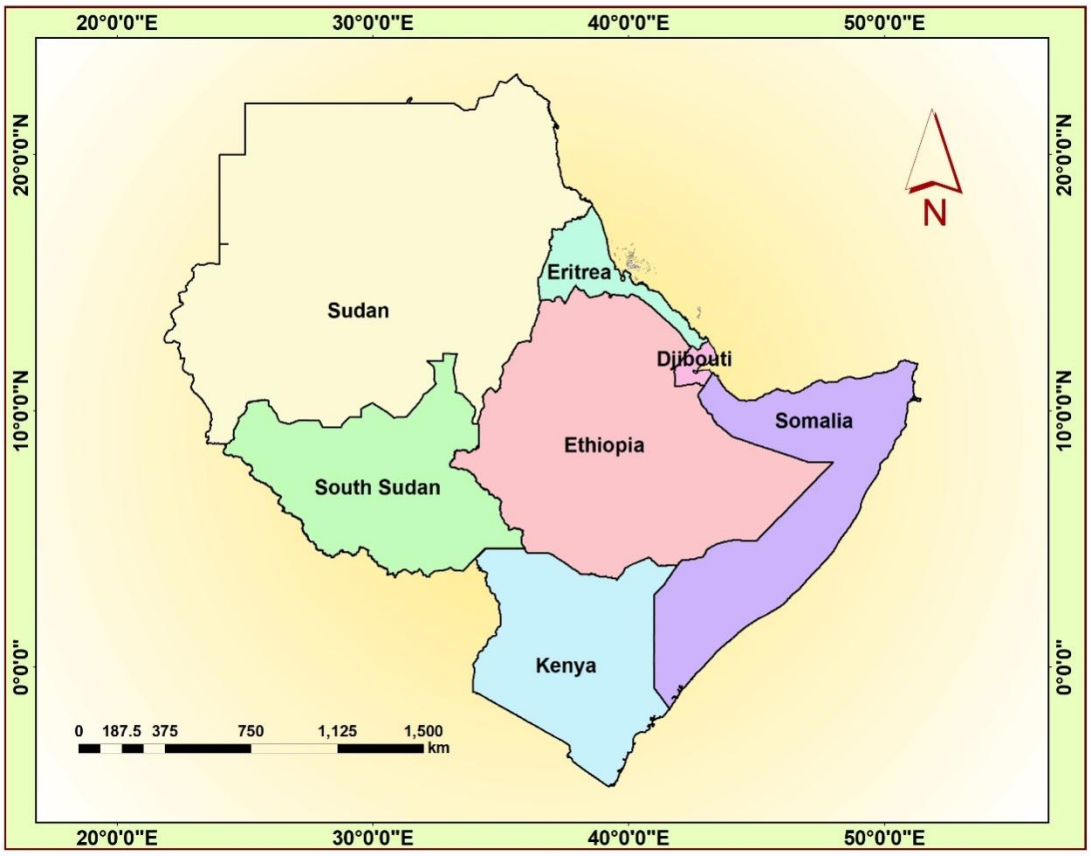


Figure 1.1.Ethiopia's location in relation to its neighboring countries

Source: Africa Map Library

1.2.2. Size of Ethiopia

Ethiopia with a total area of approximately 1,106,000 square kilometers is the 8th largest country in Africa and 25th in the World. It extends about 1,639 kilometers East-West, and 1,577 kilometers North-South. About 0.7% of the country is covered by water bodies.

The size of Ethiopia also affects both the natural and human environment of the country. The advantages and disadvantages of the size of Ethiopia are indicated in Table 1.2.

Table 1.2. Advantages and disadvantages of Ethiopia's large size

Advantages	Disadvantages
Possess diverse agro ecological zones	Demands greater capital to construct infrastructural facilities
Variety of natural resources	Requires large army to protect its territory
Own extensive arable land	Difficult for effective administration
Have larger population size	Difficult for socio-economic integration
Home for diverse cultures	
Greater depth in defense external invasion	

1.2.3. The shape of Ethiopia and its Implication

Countries of the World have different kinds of shape that can be divided into five main categories: compact, fragmented, elongated, perforated, and protruded. These shapes have implications on defense, administration and economic integration within a country. Whether some kind of shape is advantageous to a country or not, however, depends on many other factors.

- **Compact shape countries:** The distance from the geographic centre of the state to any of the borders does not vary greatly. It is easier for defence, socioeconomic and cultural integration.
- *Fragmented shape countries:* They are divided from their other parts by either water, land or other countries.
- *Elongated shape countries:* They are geographically long and relatively narrow like Chile.
- *Perforated shape countries:* A country that completely surrounds another country like the Republic of South Africa.
- *Protrude shape countries:* Countries that have one portion that is much more elongated than the rest of the country like Myanmar and Eritrea.

There are various ways of measuring shape of countries. These measures are known as the indices of compactness. These indices measure the deviation of the shape of a country from a circular shape, which is the most compact shape. Since there is no country with absolutely circular shape, those approximating a circular shape are said to be more compact.

There are four most commonly used measures of compactness. These are:

1. The ratio of area of country to its boundary length: Area-Boundary ratio. The higher the A/B ratio, the greater the degree of compactness.
2. The ratio of boundary length of a country to the circumference of a circle having the same area as the country itself: Boundary-Circumference ratio. It measures how far the boundary of a country approximates the circumference of a circle of its own size. Therefore, the nearer the ratio to 1 the more compact the country is.
3. The ratio of the area of the country to the circumference of the smallest inscribing circle: Area-Circumference ratio. It compares the area of the country with the circumference of a circle that passes touching the extreme points on the boundary of the country. The higher the A/C ratio, the greater the degree of compactness.
4. The ratio of the actual area of a country to the smallest possible inscribing circle: Area-Area (A/A') ratio. The area of the inscribing circle is the area of the smallest possible circle whose circumference passes through the extreme points on the boundary. Half-length of the longest distance between two extreme points gives radius of the inscribing circle. The nearer the ratio to 1, the more compact the country is.

Table 1.3: Ethiopia's shape compared to its neighbors in the Horn

Country	Area(km^2)	Boundary (km)	A/B ratio	B/C ratio	A/C ratio
Ethiopia	1,106,000	5,260	210.27	1.41	296.61
Djibouti	22,000	820	26.83	1.56	41.83
Eritrea	117,400	2,420	48.51	1.99	96.83
Kenya	582,644	3,600	161.85	1.33	215.28
Somalia	637,657	5,100	125.03	1.80	225.22

Source: Bekure (1982, 1983)

1.3. Basic Skills of Map Reading

Activity 1.2

1. Define a map,

2. What is marginal information of a map? How important is it to read maps?

3. State the importance of a map.

What is a Map?

A map is a two-dimensional scaled representation of part or whole of the Earth surface on a flat body such as piece of paper, black board, wood or cloth.

Map reading encompasses a systematic identification of natural features and manmade features. Natural features include mountains, plateaus, hills, valleys, river, ocean, rocks, plain etc. On the other hand, manmade features include roads, railway, buildings, dam etc. Although many disciplines use maps, they have a special significance for Geographers as primary tools for displaying and analyzing spatial distributions, patterns and relations. Since these features cannot easily be observed and interpreted in real landscapes, maps are essential to Geographers.

Importance of maps

- Provide the basis for making geographical details of regions represented i.e. the geographical facts of an area such as relief, drainage, settlement etc.
- Maps are powerful tools for making spatial analysis of geographical facts of areas represented.
- Maps are useful for giving location of geographical features by varied methods of grid reference, place naming etc.
- Maps are used on various disciplines like land use planning, military science, aviation, tourism, marine science, population studies, epidemiology, geology, economics, history, archaeology, agriculture etc.
- Map makes storage of the geographical data of areas represented.
- Maps are potentially used to asses' reliable measurements of the geographical features. The measurements can be of area size, distance etc.

Types of Map

There are many types of maps according to their purpose and functions. For the purpose of this course, topographical and statistical maps are considered.

a. **Topographical maps:** Topographic maps depict one or more natural and cultural features of an area. They could be small, medium or large scale depending on the size of the area represented. Contents of topographical maps depend on purpose of a map, scale of a map, date of compilation, and nature of the land represented.

b. **Special purpose/statistical maps:** These are maps, which show distribution of different aspects such as temperature, rainfall, settlement, vegetation etc.

Marginal Information on Maps (Elements of Maps)

Marginal information is shown on a map to enable the reading and interpretation of the geographical information of an area represented. This includes:

a. **Title:** It is the heading of the given map which tells what the map is all about.
b. **Key (legend):** It is the list of all convectional symbols and signs shown on the map with their interpretation.
c. **Scale:** It is the ratio between the distance on the map and the actual ground distance. Scales enable the map user to interpret the ground measurement like road distance, areal sizes, gradient etc. It can be expressed as representative fraction, statements/verbal scale, and linear (graphic) scale.
d. **North arrow:** It is indicated with the north direction on a map; used to know the other important directions of the mapped area like east, west, south, and west.
e. **Margin:** Is the frame of the map. It is important for showing the end of the mapped area.
f. **Date of compilation:** It is a date of map publication. This enables map users to realize whether the map is updated or outdated.

Basic Principles of Map Reading

In developing map reading abilities and skills, certain basic principles must be applied by the map-reader to translate map symbols into landscape images. Map Readers must have ideas about the symbol and also the real World (landscapes). Every map symbol must be visualized by the reader to read a map. The first symbols introduced should be those, which refer to landscape

features of which the reader already has some images. Map symbols should be introduced as needed.

Secondly, knowledge of directions is an important principle in reading maps. One of the basic functions of maps is to help us to orient ourselves and to locate places on the earth. Unless a reader knows the basic directions, he or she may not use a map effectively. Before locating features using a map, north (the north arrow) should be determined and the readers should have practice in finding this direction. Next they should learn to read direction on a specific map and the location of the features shown on the map in relation to one another.

Maps are covered in a series of lines that make up a grid. The lines have numbers accompanying them that allow you to accurately pinpoint your location on a map. Once you have located where you are, the grid system makes it simple to give an accurate description of your location. This description, which will be a series of numbers, is known as a grid reference.

Review Questions

Answer the following questions briefly.

1. What are the implications of location, shape and size of Ethiopia and the Horn on the physical environment, socioeconomic and political aspects?
2. Explain the themes of Geography.
3. What are the basic principles of map reading?

CHAPTER TWO
THE GEOLOGY OF ETHIOPIA AND THE HORN

2.1. Introduction

Geology is an Earth science that studies the evolution of the earth, the materials of which it is made of, and the processes acting upon them. Much of Geology is concerned with events that took place in the remote past when no one was around to witness them and with features which are far beneath the earth's surface where no one can see them. A great deal of geological understanding must, therefore, be obtained by inference, using clues from what can be seen and what can be measured. There are many such clues not only the rocks and landforms which can be observed and studied at the Earth's surface, but also those provided by indirect methods such as geophysics (e.g. studying earthquake waves which can penetrate deep beneath the Earth's surface), geochemistry (analysis of the detailed composition of rocks which can give clues as to their origin) and geochronology (methods for finding the ages of rocks, usually from the radioactive elements they contain).

Therefore, this chapter will focus on the geology of Ethiopia and the Horn. In this chapter, you will study the geologic forces acting up on earth and their resulting land form, geological time scale and age dating techniques.

Objectives

After completing this chapter, the students will be able to:

- *Analyze the geologic processes and the resultant land forms of Ethiopia and the Horn.*
- *Examine the formation of the Rift Valley.*
- *Recognize the current status of Ethiopian mineral endowment associated with geologic processes.*

The earth's continents were once bunched up together in to a single huge continent called ***Pangaea***. The large super continent was then split into Gondwanaland where Africa is a part and Laurasia; and later into smaller fragments over the last million years. These then drifted apart to form the present arrangement of continents.

Australian Climatologist **Alfred Wegener** proposed the hypothesis that the continents were once assembled together as a supercontinent, called the Continental drift Theory.

Wegener's principal observations were:

- ***Fit of the continents:*** The opposing coastlines of continents often fit together.
- ***Match of mountain belts, rock types:*** If the continents are reassembled as Pangaea, mountains in West Africa, North America, Greenland, and Western Europe match up.
- ***Distribution of fossils:*** The distribution of plants and animal fossils on separate continents forms definite linked patterns if the continents are reassembled.
- ***Paleoclimates:*** rocks formed 200 million years ago in India, Australia, South America, and southern Africa all exhibited evidence of continental glaciations.

2.2. The Geologic Processes: Endogenic and Exogenic Forces

Geology studies of how Earth's materials, structures, processes and organisms have changed over time. These processes are divided into two major groups: i*nternal* and *external* processes.

The internal processes (endogenic) include volcanic activity and all the tectonic processes (folding, faulting, orogenesis (mountain building), and epeirogenesis (slow rising and sinking of the landmass). These processes result in building of structural and volcanic features like plateaus, rift valleys, Block Mountains, volcanic mountains, etc.

The external (exogenic) processes are geomorphic processes. They include weathering, mass transfer, erosion and deposition. They act upon the volcanic and structural landforms by modifying, roughening and lowering them down.

The landmass of Ethiopia, as elsewhere, is the result of the combined effect of endogenic and exogenic processes. The brief geological history of Ethiopia and the Horn will be dealt chronologically starting from the oldest Era of the Earth's history to the recent.

2.3. The Geological Time Scale and Age Dating Techniques

The geological history is divided in to Eras. Each Era is divided into periods. The Eras are given names that indicate the kind of life that existed in them. For instance, the Paleozoic Era (ancient life) is the age of invertebrates, the Mesozoic Era (the middle life) is the age of reptiles while the Cenozoic Era (recent life) is the age of mammals. These geological time divisions basically differ from each other in such characteristics as the relative position of land and sea, the kind of climate and most important the kind of animal and plant life that developed and existed during that Era or period. Geological time is difficult to measure precisely.

The Earth is believed to have been formed approximately 4.5 billion years ago and the earliest forms of life were thought to have originated approximately 3.5 billion years ago. The first major boundary is defined by what was believed at the time to be the first appearance of life on earth. The span of time before life appeared was termed the Precambrian Era. To describe the geology and history of life on Earth, scientists have developed the geological time scale. The geological time scale measures time on a scale involving four main units:

1. An *epoch* is the smallest unit of time on the scale and encompasses a period of millions of years.
2. Chronologically, epochs are clumped together into larger units called *periods.*
3. Periods are combined to make subdivisions called *Eras***.**
4. An *eon* is the largest period of geological time.

The division of time units in the geological time scale is usually based on the occurrence of significant geological events (e.g. mass extinctions). As such, the geological time categories do not usually consist of a uniform length of time. The geological time scale, illustrated in Table 2.1, is built largely on the basis of life and evolution.

Table 2.1: The Geological time scale

Era	Period	Began (in Million Years)	End (my)	Major Events (million years ago)
Cenozoic	Quaternary	1.6	Present	Major glaciers in North America and Europe (1.5)
	Tertiary	70	1.6	Rocky Mountains (65), individual continents take shape.
Mesozoic	Cretaceous	146	70	Dinosaurs extinct (65), western interior seaway and marine reptiles (144 – 65)
	Jurassic	208	146	Pangaea (one land mass) begins to break up (200)
	Triassic	225	208	First mammals and dinosaurs
Paleozoic	Permian	290	225	Greatest extinction on Earth (245)
	Pennsylvanian	322	290	First reptiles
	Mississippian	362	322	Coal-forming forests
	Devonian	408	362	First land animals and first forests (408)
	Silurian	439	408	Life invades land
	Ordovician	510	439	First fish appeared
	Cambria	600	510	Great diversity of marine invertebrates
Precambrian	Proterozoic	2,500	600	Marine fossil invertebrates (600)
	Archean	4,500	2,500	Earliest fossils recorded (3,500), earliest rock formation (4,000)

Age Dating Techniques

There are two techniques of knowing the age of rocks: Relative and absolute age dating.

A. Relative Dating

Relative dating uses geological evidence to assign comparative ages of fossils. Hence, we can use two ways to know the relative age of a rock: one way is to look at any fossils the rock may contain. If any of the fossils are unique to one of the geologic time periods, then the rock was formed during that particular time period. The second way is to use the "What is on top of the older rocks?" When you find layers of rocks in a cliff or hillside, younger rocks are on top of older rocks. But these two methods only give the relative age of rocks -which one is younger and which is older.

B. Absolute Dating

Also known as Radiometric techniques. This technique was developed with discovery of radioactivity in 1896. The regular rates of decay for unstable, radioactive elements were found to constitute virtual "clocks" within the earth's rocks. Radioactive elements such as uranium (U) and thorium (Th) decay naturally to form different elements or isotopes of the same element. Every radioactive element has its own half-life.

At the end of the period constituting one half-life, half of the original quantity of radioactive element has decayed; after another half-life, half of what was left is halved again, leaving one-fourth of the original, and so on. Two of the major techniques include:

A. *Carbon-14 Technique:* Upon the organism's death, carbon-14 begins to disintegrate at a known rate, and no further replacement of carbon from atmospheric carbon dioxide can take place. Carbon-14 has half-life of 5730 years.

B. *Potassium-Argon Technique:* The decay is widely used for dating rocks. Geologists are able to date entire rock samples in this way, because potassium-40 is abundant in micas, feldspars, and hornblendes. Leakage of argon is a problem if the rock has been exposed to temperatures above 125° C (257° F), because the age of the rock will then reflect the last episode of heating rather than the time of original rock formation.

2.4. Geological Processes and the Resulting Landforms of Ethiopia and the Horn

Activity 2.1

1. Distinguish between endogenic and exogenic processes.

2. What are the major geological processes and the resulting landforms of Ethiopia and the Horn in each Era?

2.4.1. The Precambrian Era Geologic Processes (4.5 billion - 600 million years ago)

The Precambrian Era covers 5/6th of the Earth's history. Due to its remoteness in time and the absence of well-preserved fossils, our knowledge of the events is limited. Nevertheless, some general description of the main geologic processes can be made.

The major geologic event of the Precambrian Era was *Orogenesis*. As a result, the land was subjected to intense folding. This was accompanied by intrusive igneous activity. The result was the formation of huge mountain ranges. In between the ***orogenic*** periods and after the last ***orogenesis***, there were long periods of denudation, which finally reduced these mountains to near-level (***peneplained***) rock surfaces. This "levelled" surface was later (in the ***Mesozoic*** and ***Cenozoic Eras***) covered by younger rock formations. Therefore, in most parts of Ethiopia rocks belonging to this Era are found beneath all other rocks, forming the basement rocks. Since, they had been subjected to pressure and heat from overlying weight, earth movements (folding, orogenesis) and to intrusive igneous activity; the original rocks (both *sedimentary* and *igneous*) were altered into metamorphic rocks of varying stages of metamorphism. Since these same processes have allowed mineralization and crystal formation, the rocks are also collectively described as *crystalline rocks*.The Precambrian rocks are overlaid by recent rock formations. However, as surface rocks covering 25% of the land mass of the country; they are found exposed in the following areas:

In the northern part: Western lowlands, parts of northern and central Tigray.

A. In the western Part: Gambella, Benishangul-Gumuz (Metekel and Asossa), western Gojjam, western Wellega, Illuababora, and Abay gorge.
B. In the southern Part: Guji, southern Omo, and parts of southern Bale and Borena.
C. In the eastern part: Eastern Hararghe.

2.4.2. The Paleozoic Era Geologic Processes (600 million - 225 million years ago)

The Paleozoic Era lasted for about 375 million years. The major geological process of this Era was denudation. The gigantic mountains that were formed by the Precambrian orogeny were subjected to intense and prolonged denudation. At the end, the once gigantic mountain ranges were reduced to a "peneplained" surface. Undulating plain with some residual features (inselbergs) here and there was formed. The sediments were transported southward and eastward to form continental (in Africa) and marine deposits, respectively. Because of the limited deposition within Ethiopia, rocks belonging to this Era are rare in the country.

2.4.3. The Mesozoic Era Geologic Processes (225-70 million years ago)

This Mesozoic Era lasted for about 155 million years. It was an Era of alternate slows sinking and rising (epeirogenesis) of the landmass. This process affected the whole present-day Horn of Africa and Arabian landmass. At the same time the land was tilted eastward and therefore lower in the southeast and higher in the northwest.

The subsidence of the land began about 225 million years ago. As the land sank slowly the sea invaded it starting from Somalia and Ogaden and slowly spreading northwestward. This was in late Triassic. This phenomenon continued up to Jurassic period. As the shallow sea spread towards the land, sands were deposited over the peneplained Precambrian rock surface. As the depth of the sea increased, mud (shale), gypsum and later lime were deposited. The latter is associated with the flourishing of marine life and decaying and precipitating of their remains, as the sea stayed long. Hence, Mesozoic rocks are considered to have the greatest potential for oil and gas deposits.

Through time, compression by the overlying rocks and by cementing minerals, the sands and lime were compacted to form sandstone and limestone layers respectively. These are known as the Adigrat sand stone and Hintalo limestone layers. They are named after place names in Tigray where they might have been first identified.

In the Horn of Africa and Ethiopia, the slow rise of the land and consequently the regression of the sea began in the Upper Jurassic. It continued throughout the Cretaceous period. With the retreat of the sea, another process of deposition occurred. In the country sedimentation ended with the deposition of clay, silt, sand conglomerate brought in from the land as the sea receded due to uplift of the landmass. Gypsum, shale and at last sands were laid over the Hintalo

limestone. The uppermost layer is known as the Upper sandstone. By the end of the Mesozoic Era, when the land emerged out of the sea, three major sedimentary formations were laid and formed upon the Precambrian rock surface. These were the Adigrat or lower sandstone, Hintalo limestone and Upper Sandstone. As transitional formations, gypsum and shale were inter-bedded above and below the Hintalo limestone. The Mesozoic sedimentary rocks cover 25% of the land mass of the country.

Due to the tilting of the landmass during the transgression and regression of the sea, and due to the direction of the invading and retreating sea, the age and thickness of the Sandstone layers vary in a Southeast - Northwest direction. The Adigrat sandstone is older and thicker in the southeast and progressively decreases in age and thickness northwestward. The Upper sandstone, on the other hand, is thicker and younger (Upper Cretaceous) in the Southeast, while in the Northwest it is older and thinner.

The transgressing sea and Mesozoic sediments nearly covered the whole of Ethiopia. The northwestern limit was as far as central Tigray, and western slopes of Western highlands. In most parts of Ethiopia, the Mesozoic rocks are overlaid by the Cenozoic rocks. As surface rocks, these old marine sediments are extensively found in the Southeast lowlands. Other exposures include central Tigray, and along the gorges of Abay and Wabishebelle rivers

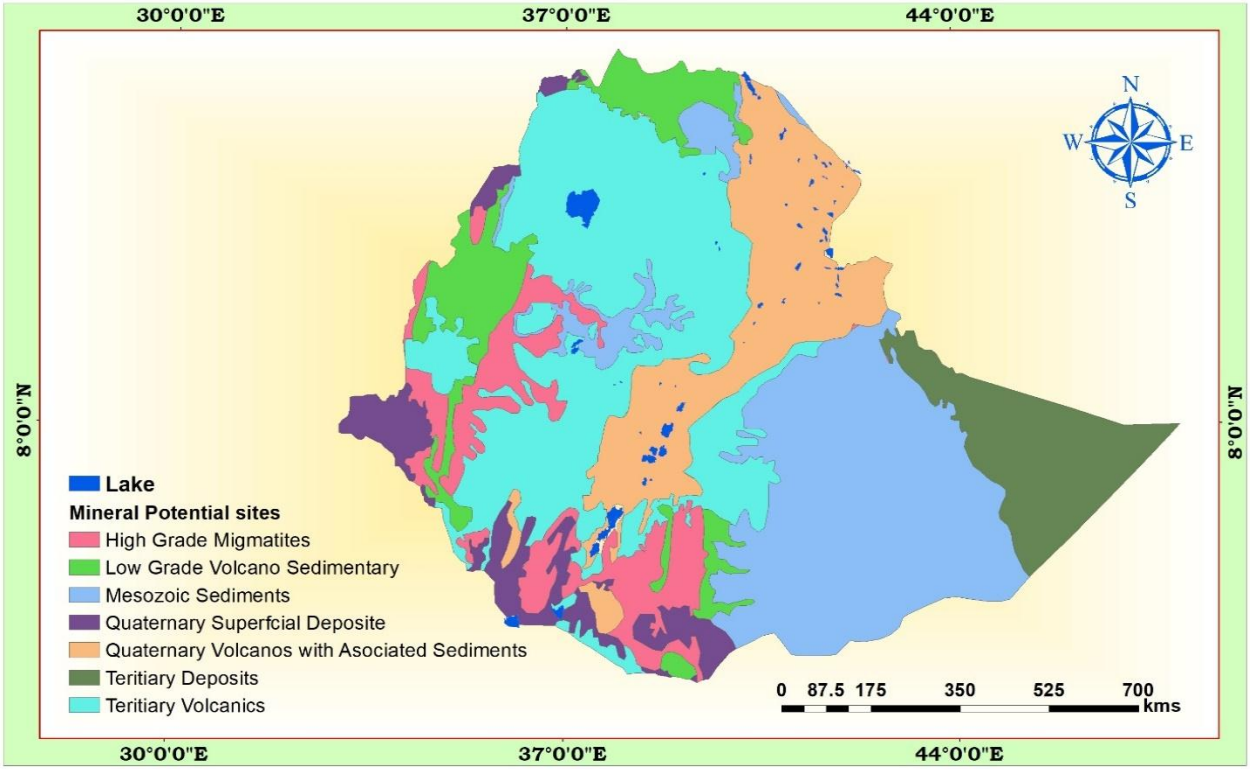


Figure 2.1. Geological map of Ethiopia *Source: CSA Shapefile, 2012*

2.4.4. The Cenozoic Era Geologic Processes (70million years ago - Present)

The Cenozoic Era is the most recent of the geologic Eras. The tectonic and volcanic activities that took place in this Era have an important effect in the making of the present-day landmass of Ethiopia and the Horn of Africa. The land was subjected to two major geologic events and other geologic processes of lesser magnitude but still important. These geologic activities are:

a. Uplifting of the Arabo-Ethiopian landmass and outpouring of huge quantity of lava.
b. Formation of the Rift Valley.
c. Quaternary volcanism and deposition.

- **Uplifting of the Arabo-Ethiopian landmass and outpouring of lava flood**

The uplifting of the whole of the Arabo-Ethiopian landmass is a continuation of the slow rise that began in the Upper Jurassic and Cretaceous periods. This huge uplift continued to the Paleocene and Oligocene epoch of the Tertiary period. Where the uplifting was of greater magnitude, the land was pushed up to a maximum height of 2,000 meters above sea level. This occurred during the Eocene epoch. This uplifting was of an epeirogenic character. It was unparalleled anywhere else except in the Alpine orogenic belts of the Andes. The whole of the Arabo-Ethiopian landmass was pushed up in blocks as one mass. The greatest uplift was in central Ethiopia. This

immense tectonic force also fractured the crust at many places. Huge quantity of lava came out through these fractures. The out pouring of this flood of basalt spread widely and extensively and covered a large part of the Mesozoic sedimentary layer to form the Ethiopian plateau surface and also the floor of the present-day Rift Valley. At that time the Rift Valley was not yet formed. The mass of lava was so immense, that it formed a thick layer of volcanic rocks on the plateau, which mounted to more than 1,000 meters above sea level in the north Central Highlands. Where the lava comes out through vents, huge volcanic rocks were piled up to form many and huge Volcanic Mountains' towering the flat basaltic plateau. This volcanic material is known as Trappean lava or Trap Series lava. Where it is not dissected by erosion, the Ethiopian plateau had flat and nearly horizontal surface. This is an expression of the peneplaned Precambrian surfaces, the smothering effect of the Mesozoic deposition, and the spreading of the Trap series lava over the Mesozoic sediments.

- **The Formation of the Rift Valley**

The formation of the Rift Valley is said to be related with the theory of plate tectonics. According to the theory, the Rift Valley may be lying on the Earth's crust below which lateral movement of the crust in opposite directions producing *tensional forces* that caused parallel fractures or faults on the sides of the up-arched swell. As the tension widened the fractures, the central part of the landmass collapsed to form an extensive structural depression known as the *Rift Valley* (Fig. 2.2).

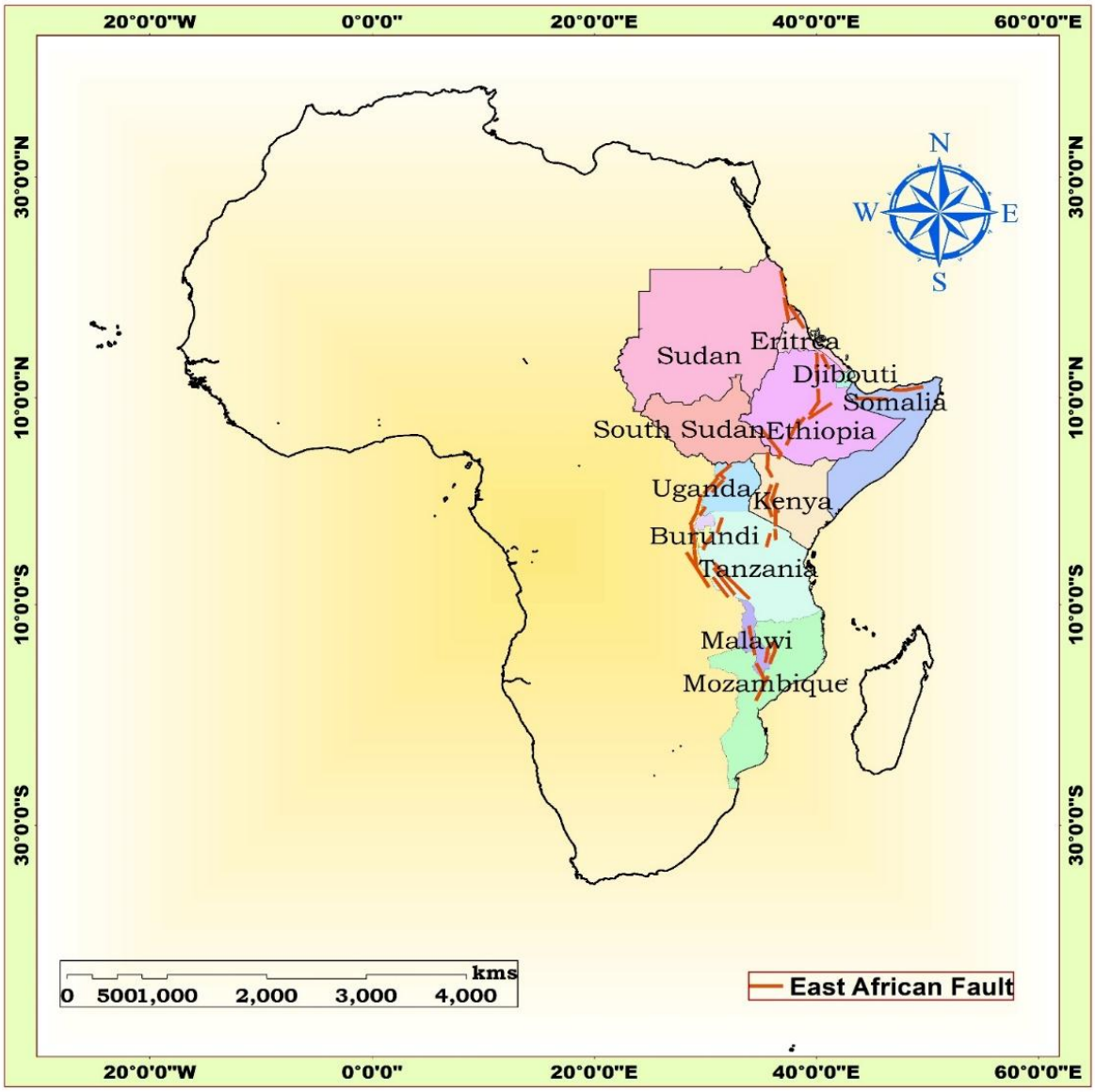


Figure 2.2.*The* ***Ethiopian and*** *East African Rift Valley systems.*

Source: Africa Map Library

The major faulting movement probably began in the late Oligocene and Miocene Epochs of the Cenozoic Era. This rifted the Red Sea trough, which began to be flooded from the north. But the major rifting, affecting the whole African Rift System, including that of Ethiopia and the Gulf of Aden took place in the Miocene Epoch. Rifting and faulting, however, continued all the time throughout the Pliocene and even the Pleistocene Epochs.

The Red Sea and the Gulf of Aden were connected as a result of the rifting and faulting of the land bridge that separated them. At the same period (Pliocene), the Afar depression (including the Gulf of Zula) was down-faulted allowing the Red Sea water to penetrate far inside. Reversed tilting and volcanic activity, later (Pleistocene) blocked the connection and isolated the extension of the sea, allowing much of the water to evaporate. As a result, thick saline materials accumulated. During the same period, the area between the Danakil Depression and the Red Sea was uplifted to form the Afar Block Mountains.

The Spatial Extent of the Rift Valley

The Ethiopian Rift Valley is part of the Great East African Rift system that extends from Palestine-Jordan in the north to Malawi-Mozambique in the south, for a distance of about 7,200 kilometers. Of these, 5,600 kilometers is in Africa, and 1,700 kilometers in Eritrea and Ethiopia. On land, the widest part of the Rift Valley is the Afar Triangle (200-300 km). The Red Sea, the Gulf of Aden, and the East African System meet and form the triangular depression of the Afar where the Kobar Sink lies about 125 meters below sea level. The formation of the Gulf of Aden and the separation of the Arabian Peninsula from the Horn of Africa also took place during the Tertiary period. The Rift Valley region of Ethiopian is the most *unstable* part of the country. There are numerous hot springs, fumorales, active volcanoes, geysers, and frequent earthquakes. The formation of the Rift Valley has the following structural (physiographic) effects:

- It divides the Ethiopian Plateau into two.
- It separates the Arabian landmass from African landmass.
- It causes the formation of the Dead Sea, Red Sea and the Gulf of Aden troughs.
- It creates basins and fault depressions on which the Rift Valley lakes are formed.

Faulting and graben formation are not only limited to the Rift Valley. For example, similar tectonics activities have occurred in the Lake Tana Basin. However, the formation of Lake Tana had been accentuated by volcanic activity so that lava flow in the southeast had dammed part of the rim to deepen the basin. Faulting in other places had a structural control along some part of the river courses.

- **Quaternary Volcanic Eruptions and Depositions**

They are recent volcanic activities that took place after the formation of the Rift Valley. This occurred in the Pliocene-Pleistocene Epochs. This is a continuation of the tectonic and volcanic

processes that earlier affected the Rift Valley formation. It occurred in the form of renewed rifting/faulting and more volcanism. This activity was generally limited to the floor of the Rift Valley and the region south of Lake Tana, where the lava covers an area of more than 3,000km^2. Aden volcanics and recent faulting are more extensively developed in the Afar region. The area is shattered by numerous faults and subjected to extensive scoriaceous basalt eruptions. The latter phenomenon is also widely manifested in the main Ethiopian Rift, especially in its northern section. Some of the eruptions have occurred in the last few hundred years. Because of their recent occurrence, the Aden volcanics have relatively well-preserved and visible morphological features. The basic volcanic features of the Aden series include the following:

- Numerous and freshly preserved volcanic cones, many of which have explosive craters. Some of these are active Dubi, Erta Ale, Afrera etc.Of these, Erta Ale is the most active volcano in Ethiopia.
- Volcanic hills and mountains, some of which are semi-dormant (Fantale, Boseti-Gouda near Adama, Aletu north of Lake Ziway, Chebbi north of Lake Hawassa etc.).
- Extensive lava fields and lava sheets some of which are very recent.
- Lava ridges.
- Thermal springs, fumaroles etc.

Quaternary Deposition

During the Quaternary period of the Cenozoic Era, the Earth experienced a marked climatic change, where warmer and dry periods were alternating with cooler and wet periods. This was the time of the last ‘’Ice Age’’ in the middle and high latitude areas and the time of the ‘‘Pluvial Rains’’ in Africa. The heavy Pluvial Rains eroded the Ethiopian plateau and the eroded materials were deposited in the Rift Valley lakes.

The excessive rain resulted in an excessive surface flow; rivers were many and large. They carried a lot of water and sediments. Lake and marshy areas became numerous and deep. Many were enlarged and covered much area and even merged together. For example, Ziway-Langano-Shalla; Hawasa-Shallo; Chamo-Abaya; and Lake Abe and the nearby smaller lakes and marsh basins formed huge lakes.

After the ‘‘Pluvial Rains’’, the Earth’s climate became warmer and drier. Thus, it increased the rate of evaporation that diminished the sizes of the lakes. Today, there are lacustrine deposits of

continental origin around many of the Ethiopian lakes, river valleys and lowlands. According to the place and manner of deposition and depositing agents these deposits are divided as follow.

a. *Lacustrine deposits:* Deposits on former lakebeds, and swampy depressions.
b. *Fluvial deposits:*Deposits on the banks of rivers, flood plains both in plateau, foothills etc.
c. *Glacio-fluvial deposits and erosional features:* These are occurred on high mountains, such as Bale and Kaka Mountains.
d. *Aeolian deposits:*Are **w**indblown deposits.
e. *Coastal and marine deposits:* Deposits on sea invaded and sea-covered places.

The quaternary deposits are mainly found in the Rift Valley (Afar and Lakes Region), Baro lowlands, southern Borena, and parts of northwestern low lands. Generally, the Cenozoic rocks cover 50% of the land mass of the country. These include Highland Tertiary volcanics (basalts), Tertiary as well as Quaternary volcanics, and sediments of the rift valley.

2.5. Rock and Mineral Resources of Ethiopia

The occurrence of metallic minerals in Ethiopia is associated with the Precambrian rocks. Although not in sufficient concentration and extent, a great variety of such minerals occur in the basement rocks. These rocks contain most of the metallic deposits known at present.

The exploitation and search for mineral deposits in Ethiopia has been taking place for the past 2,000 years or so, and its early cultures were based partially on the mineral wealth of the day. Such has been the case of gold production and utilization, which has become part of Ethiopia's history, tradition and folklore. The mining and working of iron for the manufacture of tools, utensils and weapons, and the use of salt and salt-bar all these indicate to a fairly long mining tradition. However, presently mineral production from Ethiopia has been negligible by World standards.

2.5.1. Brief Facts and Current State of Main Minerals in Ethiopia

Geological surveys proved that Ethiopia has abundant mineral resources of metals and precious metals, coal, and industrial minerals.

Gold

Gold has been mined in Ethiopia for quite long time, mainly from Benishangul-Gumuz (Metekel) and Adola. Operating mines produce gold from primary sources in such localities as Dermi-dama, Sakoro and Lega-dembi. Mechanised alluvial working is confined to the state-operated gold field of Adola. Secondary gold deposits are common in the following localities: Adola, Murmur Basin, Shakiso, Awata Basin, Dawa Basin, Ghenale Basin, Ujama Basin,Makanisa (Guba and Wombera), Kaffa. In Gambella and Illuababora (Akobo River), in Sidama (Wondo), Borena (Negele-Yabelo area) and in Benishangul-Gumuz (Sherkole), west Wellega, Mengi-Tumat-Shangul areas to the Sudanese border, and the drainage of the Didessa and Birbir.

Platinum

The Yubdo area in Wellega, is the only active Ethiopian Platinum mine. Platinum occurrences have been reported from Delatti in Wellega, and the valley of Demi-Denissa and Bone Rivers as well as Tullu Mountain area in Sidama.

Tantalum

Significant deposit of tantalum and niobium is found in southern Ethiopia. It occurs in Adola area where Kenticha Tantalum mine with resources of more than 17,000 metric tons of world class ore reserve is found.

The sedimentary and volcanic rock activities are also resourceful. Extensive lignite deposits in Ethiopia are found in Nedjo (Wellega), and in small amounts in Chilga (Gonder) are found in the sedimentary formations laid in between Trapean lava. However, important Lignite, one of the lowest ranked coal, is known to occur in many localities such as in the Beressa Valley and Ankober (North Shewa), Sululta (nearAddis Ababa),Muger Valley (West Shewa), Aletu valley (near Nedjo), Kariso and Selmi Valleys (Debrelibanos), Zega wodem gorge (near Fiche), Didessa Valley (southwest of Nekemte), Kindo and Challe Valley (Omo confluence), Adola,Wuchalle (north of Dessie), Chukga area (on Gonder-Metema road), Dessie area (near Borkena River). These areas are promise to be a good prospect to meet some of the local industrial and domestic needs.

Gemstones

Gemstones, including amethyst, aquamarine, emerald, garnet, opal, peridot, sapphire, and tourmaline occur in many parts of Ethiopia, mainly in Amhara and Oromia Regional States.

Quality Opal was first discovered by local people in Wadla and Dalanta woredas, North Wello in Amhara Regional State.

Potash

The potash reserve in the Danakil (Dallol Depression) of the Afar region is believed to be significant.

Gypsum and Anhydrite

A limited amount of gypsum is produced for domestic consumption in Ethiopia, mainly for the cement industry, but very large deposits are known to occur in sedimentary formations of the Red Sea coastal area, Danakil Depression, Ogaden, Shewa, Gojjam, Tigray, and Hararghe. Total reserves are probably enormous because the thickness of the gypsum deposits is many hundreds of meters and the formation are known to extend laterally for hundreds of kilometers.

Clay

Ethiopia is endowed with industrial clay material. Alluvial clay deposits for bricks and tile, pottery and pipe industry occur in Adola, Abay gorge, and the Rift Valley lakes region. Ceramic clay for the production of glasses, plates, bricks is found at Ambo and Adola. Tabor ceramic industry in Hawassa gets most of its raw materials from local sources.

Marble

Crystalline limestone is widespread in the basement rocks of Ethiopia. Marble has been quarried in such localities as west of Mekelle and south of Adwa in Tigray. In the east in Galetti, Soka, Ramis, Rochelle, Kumi and other valleys of Chercher Mountain in West Hararghe. In the northwestern also in areas built of Precambrian schist in Gonder, and the Dabus River and other neighboring river basins in Benishangul-Gumuz and Gojjam.

Construction stones

Basalt, granite, limestone and sandstone are important building stones. For the surfacing of roads and compaction, basalt, scoria and other volcanic rocks are extensively used. Mesozoic limestone is an important raw material for cement and chalk production. The earlier cement works at Dire Dawa and the recent ones at Muger Valley, Abay gorge (Dejen), Tigray (Messebo) are using similar raw materials from these rock formations.

2.5.2. Mineral Potential Sites of Ethiopia

According to the Ethiopian geological survey, the geologic formations that host most mineral potentials of Ethiopia includes three major greenstone belts and other formations (Fig. 2.3). These are:

1. *The Western and South-western-greenstone belt:* They contain various minerals: primary gold occurrences (Dul,Tulu-Kape,Oda-Godere, Akobo,Baruda,Bekuji-Motish and Kalaj);Yubdo Platinum, Base metals of AzaliAkendeyu, Abetselo and Kata;Fakushu Molybdenite and the iron deposits of Bikilal, Chago, Gordana and Korre, Benshagul-Gumuz-Marble, Akobo and Asosa placer gold deposits and etc.
2. *The Southern greenstone belt:*It is known as the Adola belt, which comprises the primary gold deposits and occurrences of Lega-dembi, Sakaro, Wellena, Kumudu, Megado-Serdo, Dawa Digati, Moyale and Ababa River;the columbo-tantalite of kenticha and Meleka, andthe Adola nickel deposit and other industrial minerals.
3. *The Northern greenstone belt(Tigray):* This belt comprises of the primary gold occurrences of Terakemti, Adi-Zeresenay, and Nirague.The base metals of Terer, Tsehafiemba and other parts of Tigray, Placer gold occurrences of Tigray.

Review Questions

Answer the following questions briefly.

1. What were the major geologic processes of the Precambrian and Paleozoic Eras in the Horn of Africa?
2. Explain the formation of the oldest sedimentary rocks in Ethiopia and the Horn.
3. Discuss the major geologic events of Ethiopia that took place during the Cenozoic Era.
4. Where are the major mineral potential sites of Ethiopia? Discuss each of them with the help of examples.

CHAPTER THREE

THE TOPOGRAPHY OF ETHIOPIA AND THE HORN

3.1. Introduction

The topography of Ethiopia is largely determined by the geologic activities of the Cenozoic Era. The uplifting of the Arabo-Ethiopian swell and the subsequent outpouring, spreading and thick accumulation of Trapean lava have given rise to an outward sloping highland plateau and mountains. The major faulting resulted in the division of the plateau into two broad units and the formation of a great structural valley. Faulting elsewhere and on the floor guided part of the course of some rivers. They also formed depressions on which lakes were subsequently created. Geomorphic processes brought some modification to the structural landform by river dissection and roughening on the highlands, and deposition on the lower areas.

Objectives

At the end of this chapter, the learners will be able to:

- *Describe the topography of Ethiopia and the Horn.*
- *Identify the physiographic divisions of Ethiopia.*
- *Elucidate the physiographic characteristics of the Rift Valley.*
- *Explain the impacts of relief on biophysical and socioeconomic conditions*

General Characteristics of the Ethiopian Physiography

The Ethiopian landform is characterized by great diversity. There are flat-topped plateaus, high and rugged mountains, deep river gorges and vast plains. Altitude ranges from 125 meters below sea level (Kobar Sink) to the highest mountain in Ethiopia, Mount Ras Dashen (4,620 m.a.s.l), which is the fourth highest mountain in Africa. Ethiopia has the largest proportion of elevated landmass in the African continent. It is sometimes described as the Roof of East Africa because of its height and large area. More than 50% of the Ethiopian landmass is above 1,000 meters of elevation; and above 1,500 meters makes 44% of the country. Half of this, in turn, is at more than 2,000 meters above sea level. Most of the Ethiopian Highlands are part of central and northern Ethiopia, and its northernmost portion extends into Eritrea.

The highland core, on the other hand, is encircled by semi-arid and lowlands. The Ethiopian Highlands are rugged mass of mountains, situated in the Horn of Africa. They are the most significant physical features of the country, which form the largest continuous area of its

elevation in the continent. They have been dissected by several rivers and ravines which have cut deep gorges. They have been divided into several regions and mountain systems. Most of the country consists of high plateau and mountain ranges that are sources of many rivers and streams that made the country to be described as the "Water Tower of East Africa".

The diversity in topography is accompanied by differences in other natural features such as soil, climate, vegetation and wild life. Likewise, the socio-cultural and economic phenomena are also affected by the topography.

Taking the 1,000 meters contour line for the highland-lowland demarcation, one observes the following contrasting features between the Ethiopian highlands and lowlands:

- Characteristics of Ethiopian highlands:
  - Moderate and high amount of rainfall (>600 mm per year).
  - Lower mean annual temperature (<20^0C).
  - The climate is favourable for biotic life.
  - Rain-fed agriculture is possible.
  - Free from tropical diseases.
  - Attractive for human habitation and densely settled.

The cumulative effect of all this is that, the highlands have been significant throughout Ethiopian history in the economic, cultural and political life of the people. These highlands make up nearly 56% of the area of the Ethiopia. This is further subdivided into lower highland (1,000 - 2,000 m.a.s.l), which make up 35% and higher highland (>2,000 m.a.s.l) constituting nearly 22%.

- In contrast to the highlands, the remaining 44% of the Ethiopian lowlands are characterized by:
  - Fewer amounts of rainfall and higher temperature.
  - High prevalence of tropical diseases.
  - Lower population densities.
  - Nomadic and semi-nomadic economic life.
  - Vast plain lands favourable for irrigation agriculture along the lower river basins.

3.2. The Physiographic Divisions of Ethiopia

What are the major physiographic divisions of Ethiopia? Can you explain the formation of Ethiopian rift valley? What biophysical characteristics can you mention about areas under rift in Ethiopia?

Following the structural divisions brought about by the geologic processes of the Cenozoic Era, three major physiographic units can be identified in Ethiopia. These are:

1. The Western highlands and lowlands
2. The South-eastern (Eastern) highlands and lowlands
3. The Rift Valley

3.2.1. The Western Highlands and Lowlands

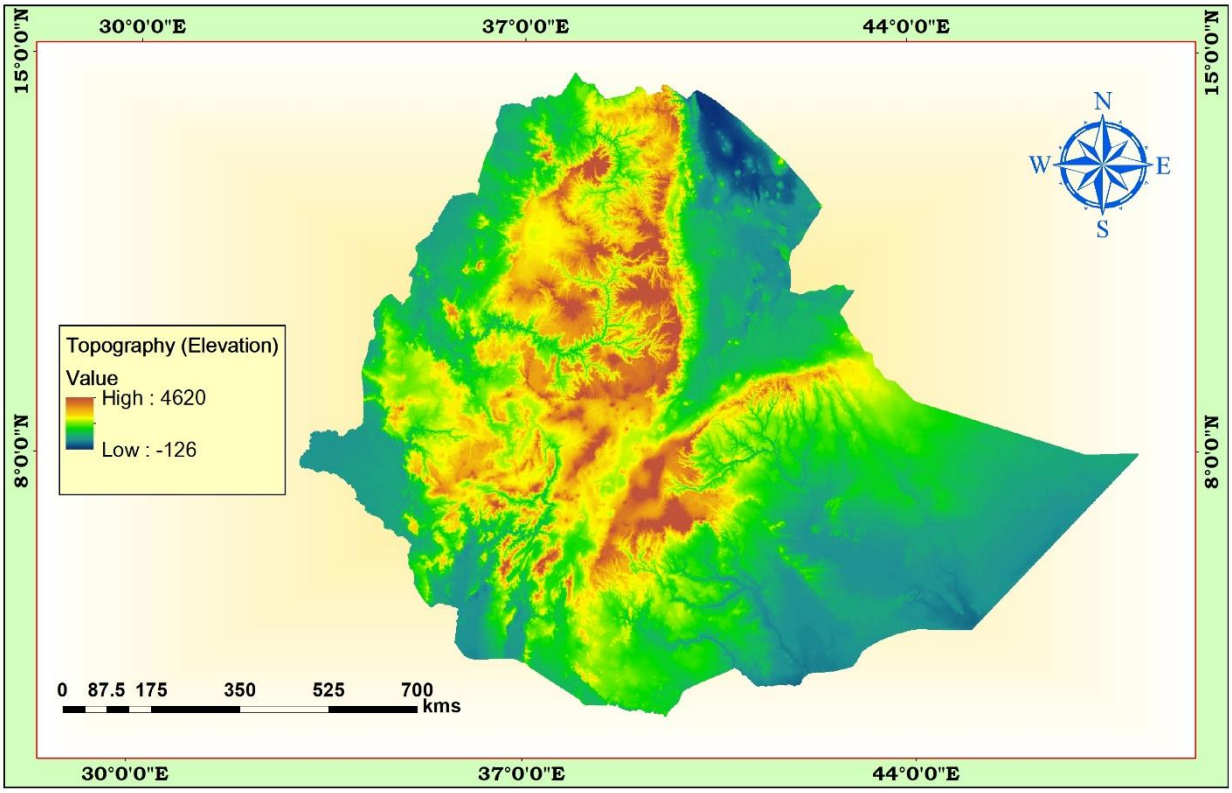
This physiographic unit includes all the area west of the Rift Valley. It extends from north to south encompassing nearly the whole western half of Ethiopia. It makes up about 44% of the area of the country. In the east the western escarpment of the Rift Valley bound it whereas westward, the land gradually descends in altitude until it merges into the western foothills and lowlands, along the Sudan and South Sudan border. This region is further subdivided into four groups of highlands (76.3%) and four groups of lowlands (23.7%) (See Fig. 3.1).

The Western Highlands

a. The Tigray Plateau

It extends from the Tekeze gorge in the south to central Eritrean highlands. The Tigray plateau is separated from the Eritrean plateau by the Mereb River. It lies to the southeast of the upper course of the Mereb/Gash River and to the northeast of Tekeze River Gorge. It constitutes about 13% of the area of the region. It is an elongated highland with most of the land being in between 1,000 and 2,000 meters above sea level. The right bank tributaries of Tekeze drain this plateau. Long period of denudation has created residual features of granite hills, rugged topography, and Ambas. There are high mountains in this plateau with elevations of over 3000 meters, namely Mount Tsibet (3988 m.a.s.l), Mount Ambalage (3291 m.a.s.l), and Mount Assimba (3248 m.a.s.l).

The famous monastery at Debre-Damo, a tableland that can only be climbed by a rope pulley is



also located in this plateau region.

Figure 3.1. Ethiopian Topography

Source: CSA shapefile, 2012

b. North Central Massifs

This Physiographic division is the largest in the western highlands. Much of its northern and southern limit follows the Abay and Tekeze gorges. The Abay, Tekeze and their tributaries have cut into this region a maze of gorges, steep sided river valleys, dividing the land into many isolated plateau blocks, precipitous tablelands and other rugged surface forms. But much of these plateau and tablelands are still capped by the Trappean lava. In its central part, the physiographic unit also accommodates the Lake Tana basin surrounded by plains of Fogera and Dembia in the north and an upland plain in its south.

Fifty-eight percent of the region is at an altitude of more than 2,000 meters, making it, next to the Shewan Plateau, the second highest physiographic division. The region consists of the Gonder, Wello and Gojjam Massifs. Out of the 26 mountain peaks with altitude of more than 4,000m.a.s.l

in Ethiopia, 19 mountain peaks are found in this physiographic region. Among these, the most popular ones include Mount Ras Dashen (4,620 m.a.s.l), Mount Weynobar/Ancua (4462 m.a.s.l), Mount KidisYared (4453 m.a.s.l), and Mount Bwahit (4437 m.a.s.l) in the Simen Mountain System. Mount Guna (4,231m.a.s.l) in the Debre Tabour Mountain System, Abune Yoseph (4,260 m.a.s.l) in the Lasta highlands of Wello and Mount Birhan (4,154 m.a.s.l) in the Choke Mountain System in Gojjam are also part of Simen Mountain System. These mountains have steep cliffs and rugged terrain that provide scenic views to climbers

The Mountain systems in Gonder and Gojjam are separated from the eastern group of mountains in Wello by impenetrable and deep gorges. At one point though, they are connected by Yeju-Wadla Delanta land bridge (ridge). This land bridge has been significant in history. It served as a route of penetration by the Turks, Portuguese, and Italians etc. The Woreta-Debre Tabor-Woldya road constructed to link the northwestern region with Asseb through Woldya and Dessie took advantage of this land bridge.

c. The Shewa Plateau/central highlands

The Shewan plateau is bounded by the Rift Valley in the east and southeast, by the Abay gorge in its northern and western limit, and the Omo gorge in the south and west. This plateau occupies a central geographical position in Ethiopia. With only 11% of the area of the whole physiographic region, the Shewa Plateau is the smallest of the Western highlands. Nearly three-fourth of its area is at an altitude of more than 2,000 meters above sea level. It has, therefore, the largest proportion of elevated ground.

The Shewa plateau is drained, outward in all directions by the tributaries of Abay, Omo, and Awash. It, therefore, forms a water divide for these three river basins. The tributaries of Abay-Guder, Muger, Jema etc. have cut deep gorges and steep sided river valleys. They have created several tablelands and isolated plateau units in the north. Similarly, the tributaries of Omo and Awash have dissected the other sides of the plateau. Otherwise, this plateau has relatively extensive flat-topped uplands, giving it the appearance of a true plateau. The highest mountain in the Shewan plateau is Mount Abuye-Meda (4,000 m.a.s.l) in Northern Shewa, Mount Guraghe in the south is 3,721 meters high.

d. The Southwestern Highlands

This Physiographic subdivision consists of the highlands of Wellega, Illuababora, Jimma, Kaffa, Gamo and Gofa. This region is separated from the adjacent highlands by the Abay and Omo river valleys. It extends from the Abay gorge in the north to the Kenya border and Chew Bahir in the south. It accounts for 22.7% of the area of the region. The region is the second largest in the Western highlands. About 70% of its area is lies within 1,000-2,000 meters altitude.

The southwestern plateau is the wettest in Ethiopia. It is drained by Dabus, Deddessa (tributaries of Abay), Baro, Akobo and the Ghibe/Omo rivers. The numerous streams have cut these highlands to produce the most dissected and rugged terrain that accommodates the most numerous and diverse ethnic linguistic groups in Ethiopia. With a height of 4,200 meters above sea level, Guge Mountain is the highest peak in this physiographic subdivision.

The Western Lowlands

These are the western foothills and border plains that extend from Western Tigray in the north to southern Gamo-Gofa in the South. In certain places, ridges or part of the highlands protrude into the lowlands, interrupting their continuity. They make 11% of the area of the physiographic region. The general elevation ranges between 500 and 1000 meters above sea level.

This physiographic sub-region is further subdivided into four by the protruding ridges. These are Tekeze lowland, Abay-Dinder lowland, Baro lowland, and Ghibe lowland from north to south.

With the exception of the *Baro* lowland, the region is generally characterized by arid or semi-arid conditions. Pastoral or semi-pastoral economic activities dominate the area. As one moves northwards, the degree of aridity increases, making rain-fed agriculture more difficult. Since one or two rivers cross all of these lowlands, irrigation agriculture is highly feasible. For example, the *Baro* lowland has an extensive flat area suitable for mechanized agriculture.

The *Ghibe/Omo* lowland, which includes the lower *Ghibe/Omo* Valley and the northern section of the Turkana basin, is classified in the Western lowlands from its geographical location. But structurally it also belongs to the Rift Valley. It is an area, which is both faulted and tectonically depressed.

In the Western lowlands, there are small but important towns. Their importance could be related to agriculture, history, or are simply border towns and frontier ports. These are *Humera, Metema, Omedla, Kurmuk, Gambella* etc.

3.2.2. The Southeastern Highlands and Lowlands

This physiographic region is the second largest in terms of area. It accounts for 37% of the area of Ethiopia. The highlands make up 46% of the physiographic division while the rest is lowland. In the west and north, the eastern escarpment of the Rift Valley makes the western and northern limit. In many places the land raises so abruptly that from the edge of the plateau one literally looks down the Rift Valley. From here, the land gradually descends southeastward into the southeastern lowlands and then to the plains of Somalia. These are further subdivided into two units of highlands and two units of extensive lowlands. These are briefly discussed as follows.

The Southeastern Highlands

A. The Arsi-Bale-Sidama Highlands

These highlands are found to the east of the Lakes Region. They are located in the south western section of the physiographic region. They make up 28.5% of the area of the region and 62% of the south - Eastern Highlands.

The Arsi Highlands are made up of flat rolling uplands and dissected mountains. The well-known mountains in this area are Mount Kaka (4,180 m.a.s.l), Mount Bada (4,139 m.a.s.l) and Mount Chilalo (4,036 m.a.s.l).

The Bale highlands are separated from the Arsi highlands by the head and main stream of Wabishebelle. They consist of a platform looking basaltic plateau in the north-central part and high mountain massif to the south. The Afro-Alpine summit of Senetti plateau is found on the latter group. The highest mountain peaks in this region are Tulu-Demtu (4,377 m.a.s.l) and Mount Batu (4,307 m.a.s.l). Erosion features belonging to Pleistocene glaciation but later modified by fluvial processes are seen in the trough-like gorges, hanging valleys, and depressions. The Arsi-Bale Highlands are important grains producing areas with still high potential.

The Sidama Highlands are separated from the Bale Highlands by the Ghenale river valley. They occupy the southwestern corner of this region. The prominent feature here is the Jemjem plateau, an important coffee growing area.

Rivers Wabishebelle and Ghenale along with their tributaries have dissected this physiographic region. Specially, Weyb River, tributary of Ghenale, has cut an underground passage (Sof Omar cave) through the Mesozoic Limestone rocks. The cave is found near Bale Mountains. It is one of the World's most spectacular and extensive underground caverns creating a magnificent view accessible only by an underground stream.

B. The Hararghe Plateau

This plateau is a north-easterly extension of the south-eastern highlands. It extends from the Chercher highlands in the south-west to Jigjiga in the east. It makes up 38% of the South Eastern highlands and 17.4% of the whole physiographic region. It has the smallest proportion of upper highland (>2,000 meters). It is a low lying and elongated region.

Rising sharply from the Rift Valley floor, it immediately but gently descends east and southeastward. The left-bank tributaries of Wabishebelle drain it. Much of the Trappean lava is removed and the Mesozoic rocks are extensively exposed. The highest mountain here is Mount Gara-Muleta (3,381 m.a.s.l).

The Southeastern Lowlands

The Southeastern lowlands are located in the southeastern part of the country and they are the most extensive lowlands in Ethiopia. They make up 54% of the area of the physiographic region and around one-fifth of the country. This region is divided into Wabishebelle plain (60%) and the Ghenale Plain (40%). They include the plains of Ogaden, Elkere, and Borena. Southeastward sloping plains characterize these lowlands. These extensive plains are interrupted here and there, by low hills, low ridges, inselbergs and by shallow and broad river valleys and depressions.

Because of the harsh climatic conditions, these lowlands are little used and support very small population. They are sparsely inhabited by pastoral and semi-pastoral communities. The economic potential for this region includes animal husbandry, irrigation, agriculture and perhaps exploitation of petroleum and natural gas.

3.2.3. The Rift Valley

The Rift Valley is a tectonically formed structural depression. It is bounded by two major and more or less parallel escarpments. The formation of the Rift Valley has separated the Ethiopian Highlands and Lowlands in to two. It extends from the Afar triangle in the north to Chew Bahir for about 1,700 km^2. It covers 18% of the area of Ethiopia. It is elongated and funnel shaped, with a NE-SW orientation. It opens out in the Afar Triangle, where it is the widest, and narrows down to the south.

The floor of the Rift Valley is made up of interconnected troughs, grabens and depressions. Volcanic rocks, fluvial and lacustrine deposits cover the floor. In many places, numerous volcanic domes, hills and cinder cones rise from the floor. Altitude in the floor ranges from 125 meters below sea level at Dallol Depression, to as high as 2,000 meters above sea level in the Lakes region. The bounding escarpments are also of varying heights. From the floor to the edge of the escarpment, the heights vary from 200 to 1500 meters. Because of its altitudinal variation and positional differences, the climate also varies from warm, hot and dry to cool and moderately moist conditions. Similarly, the social and economic life reflects this pattern. There are places, which are desolate and sparsely inhabited by pastoralists where as in others parts people practice some rain-fed agriculture.

The Rift Valley is further subdivided into three physiographic sub-regions. These are the Afar Triangle, the Main Ethiopian Rift, and the Chew Bahir Rift. A brief description of each sub-division is given below.

i. The Afar Triangle

The Afar Triangle is the largest and widest part of the Rift Valley. It makes up 54% of the Rift Valley area. It is bounded by the high western and eastern escarpments in the west and east respectively, and by the Afar and Aisha Horst in the northeast. The area is generally of low altitude (300-700 meters).

Quite different is the morphology of the Afar depression, triangular-shape lowland, where elevation drops uniformly from approximately 1,000 meters in the southwest to below sea level in the north (**Danakil depressio**n) and in the east, where the shores of Lake Asal, fluctuating at around 125 meters below sea level, represent the lowest subaerial point of the African continent.

The depression, which hosts one of the most hostile environments on Earth (maximum temperatures can exceed 50°C during the summer wet season; Dallol, at the northern tip of Afar.

The area is characterized by faulted depressions (grabens), volcanic hills, active volcanoes, volcanic ridges, lava fields and low lava platforms. Lakes (*Abe, Asale*, and *Afrera)* occupy some of these basins. A prominent feature in this region is the *Denakil Depression* (*Kobar Sink*). Separated from the Red Sea by a 200 meters high land barrier, much of it lies below sea level. A larger part of this is covered by thick and extensive salt plain. Lake Asale and Lake Afreraoccupy the lowest parts of this sunken depression.

The Afar Triangle is generally hot and dry. The only respite one gets in the Southern part is from the waters of the Awash River. The economic importance of this region includes salt extraction, irrigation along the Awash River and electric potential from geothermal energy.

ii. The Main Ethiopian Rift/Central Rift

It refers to the narrow belt of the Rift Valley that extends from Awash River in the north to Lake Chamo in the south. It is bounded by the western and eastern escarpments. With the exception of the Arbaminch area, the bounding escarpments are generally low. This part of the Rift Valley is the narrowest and the highest. It has an average width of 50-80 kilometers and general elevation of 1,000-2,000 meters above sea level.

The floor in many places is dotted by cinder cones and volcanic mountains. The big ones include Mount Fentale, Boseti-guda (near Adama), Aletu (north of Lake Ziway) and Chebi (north of Lake Hawasa). The northern section has more of these cinder cones and lava fields. The prominent features, however, are the numerous lakes formed on tectonic sags and fault depressions.

Because of altitude, the lakes region of the Main Ethiopian Rift is generally milder and watery. Here rain-fed agriculture is practiced. Other resource bases include the recreational value of the lakes, the agricultural importance of some streams and lakes, and the geothermal energy potential.

iii. The Chew Bahir Rift

This is the smallest and the southern-most part of the Rift Valley. Gneissic highlands of Konso and the surrounding highlands separate it from the Main Ethiopian Rift to the north. The

characteristic feature of this region is the broad and shallow depression, which is a marshy area covered by tall grass, into which the Segen and Woito streams empty.

3.3. The Impacts of Relief on Biophysical and Socioeconomic Conditions

The highly dissected character of the landscape over much of the country's territory along with the limited extent to which flat surfaces are present influence the various socioeconomic aspects of Ethiopia as presented hereunder.

1. Agricultural practices

Relief influences farm size and shape in that in an area of rugged terrain the farmlands are small in size and fragmented and tend to be irregular in shape.

- Choice of farming techniques and farm implements are highly influenced by relief as in rugged terrain mechanized farming techniques are difficult to practice.
- Relief influences crop production as some corps are well adapted to higher altitudes (barley, wheat) and others to low altitude (sorghum, maize).
- The practice of animal husbandry is also influenced by relief as most equines and sheep are reared in the higher altitudes and camels and goat are well adapted to lower altitudes

2. Settlement pattern

- Highlands of Ethiopia that experience a temperate type of climatic condition that are mainly free from most of the tropical diseases are densely settled.
- Rugged and difficult terrain hinders the development of settlement and its expansion.
- The highlands of Ethiopia are characterized by sedentary life and permanent settlements while lowlands that are inhabited by pastoralists have temporary settlements.

3. Transportation and communication

- The highly dissected nature of the landscape is a barrier to the development of internal surface transportation that resulted in the long-term isolation of many communities
- The difficult terrain makes infrastructure development and maintenance costly.
- TV and radio communications are also highly influenced by relief.
- The rugged topography rendered rivers less navigable due to the waterfalls, deep gorges and steep cliffs.

4. Hydroelectric power potential

- The great difference in altitude coupled with high rainfall created suitable conditions for a very high potential for the production of hydroelectric power in Ethiopia.

5. **Socio-cultural feeling**
   - ➲ The rugged terrain as a result of excessive surface dissection resulted in the long-term isolation of communities that led to the occurrence of cultural diversity.
   - ➲ People who live in the highlands have been identifying themselves as *degegnas* (mountaineers) and those who live in the lowlands as *kollegnas* (lowlanders).
6. **Impacts on climate**
   - ➲ The climate of Ethiopia is a result of the tropical position of the country and the great altitudinal variation of the general topography.
   - ➲ Highlands with higher amount of rainfall and lower rate of evapo-transpiration tend to be moisture surplus compared to the moisture deficit lowlands.
7. **Impacts on soil**
   - ➲ Steep mountain slopes provide low angle of rest, unstable surface materials and subject to degradation processes and relatively form shallow and little developed soils.
8. **Impacts on natural vegetation**
   - ➲ Relief through its effect on climate and hydrology affect the type of natural vegetation grown in an area.

Review Questions

Answer the following questions briefly.

1. What are the impacts of relief on the biophysical and socioeconomic conditions of Ethiopia?
2. Discuss the physiographic characteristics of the southeastern highlands and lowlands.

CHAPTER FOUR
DRAINAGE SYSTEMS AND WATER RESOURCE OF ETHIOPIA AND THE HORN

4.1. Introduction

About 71% of the earth's total surface is covered by water bodies majorly occupied by seas and oceans. Of the earth's total water surface, nearly 97.5% is alkaline accumulated in seas and oceans. The remaining 2.5% is fresh water, of which nearly 68.7% is deposited in glaciers, 30.1% in ground water, 0.8% in permafrost and 0.4% in surface waters. Water in lakes, rivers, atmosphere, soils and wetlands are considered as surface waters. Surface and ground waters are by far the most abundant and easily available fresh waters. However, fresh water is distributed unevenly throughout the world following varied latitudinal locations, climatic and topographic setups.

As you have discussed in the third chapter, the topographic setup of Ethiopia is characterized by complex blend of massive highlands, rugged terrain, and low plains. The diverse topographical setup, relatively higher rainfall and its nearness to equator made the country to have larger volume of ground and surface water. Around 0.7 % of the total land mass of Ethiopia is covered by water bodies. Although it requires further detailed investigation, the country's surface water potential as studied in different integrated river basin master plans is estimated to be 124.4 billion cubic meters (BCM). Consequently, many call Ethiopia, the water tower of ***"Eastern Africa"***.

Objectives

At the end of this chapter you will be able to:

- Describe the major drainage systems in Ethiopia and the Horn,
- Examine the surface and ground water resource potentials of Ethiopia,
- Understand economic potentials of the water sector in Ethiopia.

4.2. Major Drainage System of Ethiopia

How do you conceptualize drainage system?

The flow of water through well-defined channel is known as drainage. A drainage system is made up of a principal river and its tributaries (the rivers that flow into it). A river system begins

at a place called the source or headwater and ends at a point called mouth. Therefore, a drainage system is branched network of stream channels together with the adjacent land slopes they drain. The drainage pattern of an area is the outcome of the geological processes, nature and structure of rocks, topography, slope, amount and the periodicity of the flow.

A drainage basin is the topographic region from which a river and its tributaries collect both the surface runoff and subsurface flow. It is bounded by and separated from other river basins by a water divide or *topographic divide.* The general patterns of major river basins in Ethiopia are determined by topographical structures which can be clarified as:

a. The topography of the outward sloping of the *Western and South eastern plateaus*
b. The structural formation *of the Rift Valley* with its in-ward-sloping escarpments resulting mainly in an inland drainage system.
c. Faults and joints that structurally influence part of the courses of many rivers.

The Major Drainage Systems

Why do rivers rise from higher slope and flow towards the lower?

Following the complex physiographic setup and geological makeup, Ethiopia possesses three broadly classified drainage systems namely ***Western, Southeastern and Rift Valley***Drainage Systems. Western and the Southeastern drainage systems are separated by the Rift Valley system.

4.2.1. The Western Drainage Systems

The Western Drainage Systems are the largest of all drainage systems draining *40 percent* of the total area of the country and carry *60 percent* of the annual water flow. Most of the catchment area coextends with the westward sloping part of the western highlands and western lowlands. This drainage system comprises four major river basins namely the *Tekeze, Abay, Baro-Akobo, Ghibe (Omo).* Unlike other river basins in the system, the Ghibe (Omo) flows southward. The *Abay, Tekeze* and *Baro* flow westward ultimately joining the Nile which finally ends at Mediterranean Sea.

The largest river both in volumetric discharge and coverage in the western drainage systems is the *Abay* (***Table 4.1***). Abay river basin covers an area of 199,812 km^2, covering parts of Amhara, Oromia and Benishangul-Gumuz regional states. Together with its tributaries, most of which are

left-bank tributaries; it carries *65 percent* of the annual water flow of the region. Abay which rises from Lake Tana (some sources indicate its origin from *Sekela, Choke mountain*) flows about 1,450 kilometres and joins the White Nile in Khartoum, Sudan to form the *Nile River*. More than 60 streams drain the Abay within elevation ranging between 500 - 4261 meters above sea level. The largest of these is *Ghilgel Abay* (*Little Abay*). Abay flows eastward, turns *180°* to make a large bend and after cutting an impressive and deep gorge emerges out in the west.

Similarly, the *Tekeze* and its tributaries, carrying *12 percent* of the annual water flow of the region drains *82,350 Km*^{2} of land surface within elevation ranging between *536-4517* meters above sea level. Erosion in the basin resulted in large tablelands, plateau blocks and isolated mountain groups. The basin has two main tributaries (Angereb and Goang) which rises in the central highlands of Ethiopia. Tekeze River is termed *Atbara* in Sudan, which is a tributary of the Nile. The total mean annual flow from the basin is estimated to be *8.2 billion metric cubes (BMC, here after).*

The *Baro-Akobo* and *Ghibe / Omo* rivers drain the wettest highlands in the south and southwestern Ethiopia. They carry *17 percent* and *6 percent* of the annual water flow respectively. The Ghibe/ Omo river basin drains an area of 79,000 km^2 with an estimated mean annual flow of 16.6 BMC. In the lower course, the *Baro River* flows across an extensive marshy land. Baro Akobo river basin has an area of 75,912 km^2, covering parts of the Benishangul-Gumuz, Gambella, Oromia, and SNNPR. The total mean annual flow from the river basin is estimated to be 23.6 BMC. The *Baro* together with *Akobo forms the Sobat River* in South Sudan. The *Ghibe / Omo* River finally empties in to the Chew-Bahir at the mouth of Lake Turkana (an elongated Rift Valley lake) thereby forming an inland drainage.

4.2.2. The Southeastern Drainage Systems

Nearly the entire physiographic region of southeastern part of Ethiopia is drained by the southeastern drainage systems. The basin which is mainly drained by *Wabishebelle* and *Ghenale*, slopes south-eastwards across large water deficient plains. Major highlands of this basin include plateaus of *Arsi, Bale*, *Sidama* and *Harerghe*. Wabshebelle and Ghenale rivers cross the border into Somalia, carrying *25 percent* of the annual water flow of Ethiopia.

Ghenale River basin has an area of 171,042 km^2, covering parts of Oromia, SNNPR, and Somali regions. Ghenale, which has fewer tributaries but carries more water than *Wabishebelle*, reaches

the Indian Ocean. The basin flows estimated to be 5.8 BMC within elevation ranging between 171-4385 meters above sea level. In Somalia it is named the *Juba River*.

Wabishebelle with a total catchment area of 202,697 km^2, is the largest river in terms catchment area. It drains parts of Oromia, Harari and the Somali regions. It is the longest river in Ethiopia. Its tributaries are mainly left bank and, most of them, are intermittent. Despite its size, the Wabishebelle fails to reach the Indian Ocean where at the end of its journey it flows parallel to the coast before its water disappears in the sands, just near the *Juba River*.

Figure 4.1. Drainage Basins of Ethiopia

Source: CSA shapefile, 2012

4.2.3. The Rift Valley Drainage System

The Rift Valley drainage system is an area of small amount of rainfall, high evaporation and small catchment area. The size of the drainage area is restricted by the outward sloping highlands, which starts right from the edge of the escarpment. The Rift Valley drainage system is therefore left with the slopes of the escarpment and the Rift Valley floor itself as the catchment area.

The only major river basin is that of the Awash. Awash river basin has a catchment area of 114,123 km^2 and has an average annual discharge of 4.9 billion cubic meters. The Awash River originates from *Shewan plateau* in central highlands of Ethiopia, and flows 1250 kms. It covers parts of the Amhara, Oromia, Afar, Somali, Dire Dawa, and Addis Ababa City Administration. Awash is the most utilized river in the country.

In the Rift Valley drainage systems, there is no one general flow direction, as the streams flow in all directions. Following the Rift Valley orientation, the Awash flows in a northeast direction. It finally ends in a maze of small lakes and marshy area; the largest of which is Lake Abe on the Ethio-Djibouti border.

The Afar drainage sub-basin has practically no stream flow. It is an area of little rain, very high temperature and very high evaporation. *Lake Afrera* and *Asale* are the only main surface waters in the basin which are not the result of any meaningful surface flow. Their formation is related to tectonic activities.

The Southern part of the Rift Valley sub-basin is characterized by a number of lakes and small streams. It is also described as lakes region. The lakes occupy fault depression. There are small streams that drain down from the nearby mountain slopes which supply water to the lakes. For example, *Meki* and *Katar* Rivers flow into *Ziway; Bilate* into *Abaya*; and *Segen* into *Chew Bahir*. Likewise, some of these lakes are interconnected. Lakes *Ziway* and *Langano* drain into Lake *Abijiata* through the small streams of *Bulbula* and *Horocolo* respectively.

4.3. Water Resources: Rivers, Lakes and Sub-Surface Water

Why do majority of Ethiopian rivers end at seas and oceans?

4.3.1. The Ethiopian Rivers

Unlike many other African countries, Ethiopia is endowed with many rivers. Majority of the rivers originate from highland areas and cross the Ethiopian boundary. Altogether, Ethiopian rivers form 12 major watersheds (see fig. 4.1) separating the Mediterranean Sea from the Indian Ocean drainage systems.

Table 4.1: Data on major Ethiopian rivers

River	Catchment Area(km^2)	Annual Volume BMC	Terminus/Mouth	Major tributaries
Abay	199,812	4.5	Mediterranean	Dabus, Dedessa, Fincha, Guder, Muger, Jema, Beshilo
Wabishebelle	202,697	3.4	Coast of Indian Ocean	Ramis Erer, Daketa Fafan
Genale Dawa	171,042	6	Indian-Ocean	Dawa, Weyb, Welmel, Mena
Awash	114,123	4.9	Inland (within Ethiopia)	Akaki, Kesem, Borkena, Mile
Tekeze	87,733	8.2	Mediterranean	Goang, Angereb
Gibe (Omo)	79,000	16.6	Lake Turkana	Gojeb
Baro Akobo	75,912	23.23	Mediterranean	Akobo

Source: Compiled from different basin development master plans

General Characteristics of Ethiopian Rivers

Owing to the highland nature of the Ethiopian landmass, surface ruggedness, the outward inclination of the highlands, and the climatic conditions, Ethiopian rivers have the following characteristics.

- Almost all major rivers originate from the highlands elevating more than 1500 meters above sea level,
- Majority of Ethiopian rivers are trans-boundary,
- Due to the marked seasonality of rainfall, Ethiopian rivers are characterized by extreme seasonal fluctuation. In the wet season, runoff is higher and rivers are full bursting their banks, destroying small bridges, damage roads and flooding low lands; during the dry seasons they became mere trickles of water or even dry up,
- Due to surface ruggedness they have rapids and waterfalls along their course,
- They have cuts, steep-sided river valleys and deep gorges along their courses,
- Rivers in Ethiopia flow on steep slopes having steep profiles.
- Some of the rivers *serve as boundaries, both international and domestic administrative units.*

4.3.2. The Ethiopian Lakes

Why do majority of lakes in Ethiopia are clustered in rift valley system?

We have lakes already dried and drying up. How do you think that happened?

Relatively Ethiopia is rich in lakes. Almost all Ethiopian lakes are result of tectonic process that took place during *Quaternary* period of *Cenozoic* era. Except few Ethiopian lakes, majority of lakes are located within the Rift Valley System. The lakes in the drainage are mainly formed on faulted depressions and are clustered along the system forming linear pattern.

Lake *Tana*, the largest lake in Ethiopia (***Table 4.2***) occupies a shallow depression in the highlands. The Tana depression is believed to be formed following slower sinking and reservoir by lava flow between Gojjam and Gonder massifs. Ethiopia is also gifted with crater lakes. These include the lakes at and around *Bishoftu, Wonchi* (near *Ambo), Hayk* (near *Dessie)* and the Crater Lake on top of *Mount Zikwala*. *Lake Ashenge* (Tigray) is formed on a tectonic basin. Other types of lakes in Ethiopia are man-made such as Lakes *Koka, Fincha* and *Melka Wakena*, and many other lakes dammed following hydroelectric power generation projects.

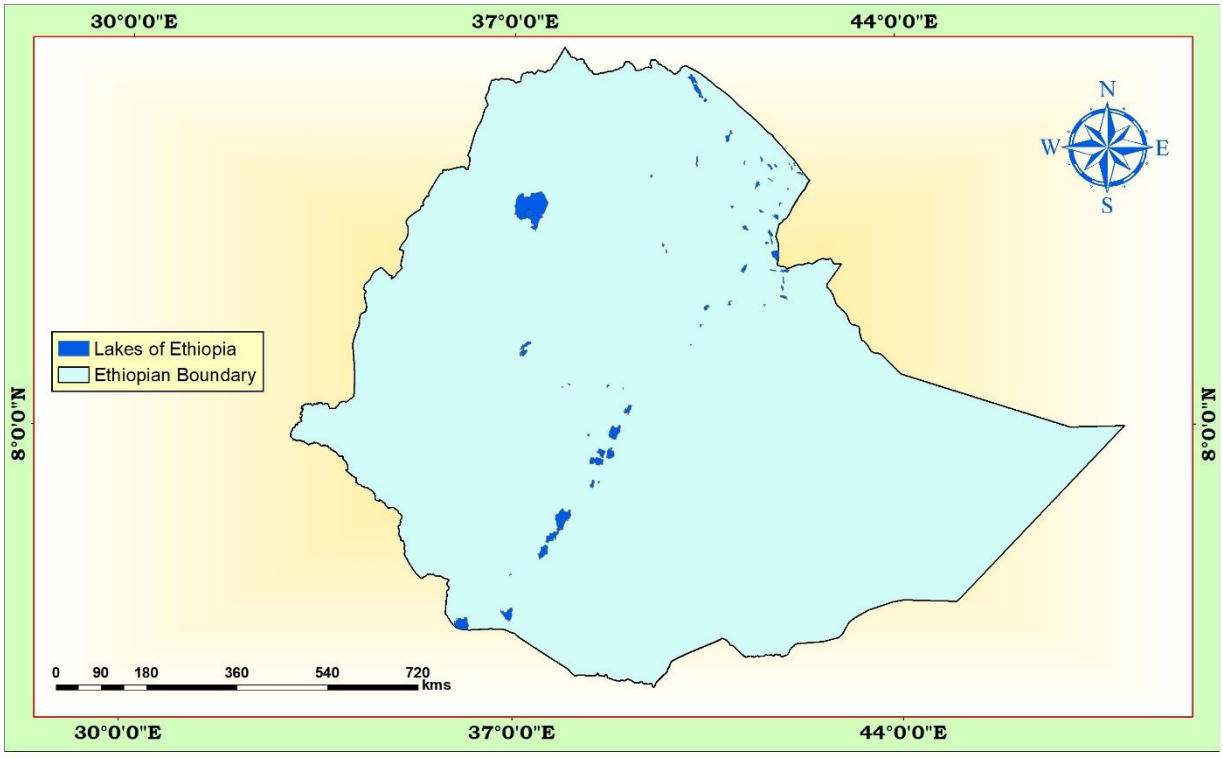


Figure 4.2. Lakes of Ethiopia

Source: CSA shapefile, 2012

Cluster of lakes are lined up within main Ethiopian rift. *Lake Abaya* is the largest of all the lakes in the system. The southern tip of the Rift Valley forms the marshy land called the *Chew Bahir*which is drained by *Segan* and *Woito*. Shala and Ziway are the shallowest and the deepest lakes in the central Ethiopian Rift (*Table 4.2*).

Table 4.2: Area and depth of some of Ethiopian Lakes

Lake	Area (km^2)	Max. Depth(m)	Lake	Area (km^2)	Max. Depth(m)
Tana	3600	9	Abijata	205	14
Abaya	1162	13.1	Awassa	129	10
Chamo	551	13	Ashenge	20	25
Ziway	442	8.95	Hayk	5	23
Shala	409	266*	Beseka	48.5	11
Koka	205	9			

Source: Compiled from different sources

4.3.3. Subsurface (Ground) Water Resource of Ethiopia

As compared to surface water resources**,** Ethiopia has lower ground water potential. However, there exists higher total exploitable groundwater potential. Climatic and geophysical conditions determine the availability of groundwater resource. Based on existing scanty knowledge, the groundwater potential of Ethiopia is estimated to be *2.6 - 6.5 BMC.* However, this estimate is now considered underestimated. Considering various separate studies, Ethiopian potential of groundwater is believed to range between 12-30 BMC.

4.4. Water Resources Potentials and Development in Ethiopia

The potential of exploitable water in Ethiopia is huge, so why is our agriculture still rainfed?

What do you think are reasons that diminish the irrelevance of Ethiopian rivers for transportation?

The enormous water resource potential of Ethiopia is underutilized due to so many factors. However, there are plenteous of opportunities that can transform the resource into our collective social and economic needs. The followings are some of potential development uses of water resource of Ethiopia.

a) Hydro-electric Potential

Ethiopian rivers have a very high potential for generating electricity. The exploitable potential of hydroelectric power is estimated at about 45000 megawatts. The first hydroelectric power generation plant was installed on Akaki River (Aba Samuel) in 1932. Currently many hydroelectric power dams are operating and many others are under construction to realize Ethiopia's ambitious energy goals. Grand Ethiopian Renaissance Dam (GERD) is the country's largest dam under construction aiming to generate 6400 megawatts. Gilgel Gibe III hydropower project has gone operational generating 1870 megawatts. Currently Ethiopia is administering 14 hydroelectric power plants constructed on Lake Aba Samuel, Koka, Tis Abay, Awash, Melka Wakena, Sor, Fincha, Gibe/Omo, Tana Beles and Tekeze, generating close to 4000 megawatts of energy.

Besides the domestic use of generated electricity, the country is exporting electricity to the neighboring countries. The major problem related to the use of Ethiopian rivers for the generation of hydroelectric power is the seasonal flow fluctuations and impact of climate change and variabilities. The severe erosion from the highlands and sedimentation in the reservoirs is also a critical problem for hydroelectric power generation.

b) Irrigation and Transportation

The terrain in Ethiopia is so rugged that it limits the uses of Ethiopian rivers both for irrigation and transportation. In the highlands, steep slopes, rapids, waterfalls, narrow and deep valleys and gorges are important obstacles. But on the lowlands, their demand for irrigation is high. Regardless of existing physiographic setups, Ethiopia's potential of irrigation is estimated to be 5.3 million hectares.

The *Baro-Akobo and Genale Dawa* river systems have large irrigation potential compared to other basins. Despite the untapped irrigation practice, more than 60% of the area under irrigation so far is located in Rift Valley Drainage System. Except few, majority of hydro-electric reservoirs are multi-purpose and are expected to contribute for irrigation.

Majority of Ethiopian rivers are not suitable for transportation. The *Baro* at its lower course is the only navigable river. Comparatively, Ethiopian lakes are much suitable for transportation than rivers. Lake Tana and Abaya are relatively the most used for transportation.

c) Fishing and Recreation

The majority of Ethiopian lakes are rich in fish. Currently the annual production of fish is estimated to be 31.5 thousand tons. The exploitable potential is however, by far greater than the current production. Exploitable fish potential in lakes varies. Currently Lake Tana leads the potential by estimated 8,000-10,000 tons per year. Fish production from Lake Chamo is estimated at 4,500 tons per year. However, more than 60% of fish supplies are coming from Ethiopian main Rift Valley lakes. However, some of the lakes are currently threatened by sedimentation, invasive species (water hyacinth), over exploitation and expansion of investments around lakes.

There are a variety of fish, birds and other aquatic life forms in the lakes. This and the scenic beauty of the lakes, the hot springs around them, the spectacular river gorges and the most impressive waterfalls make Ethiopian rivers and lakes important recreational and tourist attractions. As they are the natural habitat of a variety of wild life, some of which are only endemic to Ethiopia, their value for scientific purposes is immense.

Check!

1. Discuss the major drainage systems of Ethiopia.
2. Explain the hydroelectric and fishing potential of Ethiopian water resource.
3. State the major characteristics of Ethiopian rivers?
4. How do you justify the origin and flow direction of Ethiopian rivers?

CHAPTER FIVE
THE CLIMATE OF ETHIOPIA AND THE HORN

5.1 Introduction

Ethiopia as a large country in the Horn of Africa, is characterized by a wide variety of altitudinal ranges and diverse climatic conditions. In addition, because of its closeness to the equator and the Indian Ocean, the country is subjected to large temporal and spatial variations in elements of weather and climate.

The climate of Ethiopia is therefore mainly controlled by the seasonal migration of the ***Intertropical Convergence Zone*** (ITCZ) and associated atmospheric circulations as well as by the complex topography of the country.

Weather is the instantaneous or current state of the atmosphere composing temperature, atmospheric pressure, humidity, wind speed and direction, cloudiness and precipitation. Weather parameters are measured using various instruments. In general, the weather that impacts the surface of the Earth and those that live on the surface takes place in the troposphere.

Climate refers the state of the atmosphere over long time periods, decades and more. It is the composite of daily weather conditions recorded for long periods of time. Climate also takes into account the extremes or variations that may occur beyond the average conditions.

Hence, in this chapter, climate of Ethiopia and the Horn will explicitly be discussed. Elements and controls of weather and climate, spatiotemporal patterns of weather and climate, agro-ecological zones, climate and its implication on Ethiopian biophysical and socio-economic aspects, and climate change will be the major sub sections of this chapter.

Objectives

Upon the completion of this chapter, you will be able to:

- Distinguish between weather and climate,
- Explicate the spatiotemporal patterns and distribution of temperature and rainfall in Ethiopia,
- Analyse climate and its implications on biophysical and socioeconomicaspects,
- Comprehend the causes, consequences andresponse mechanisms of climate change.

5.2. Elements and Controls of Weather and Climate

What elements do you consider to define weather condition of your locality?

All weather conditions may be traced to the effect of the Sun on the Earth. Most changes in weather involve large scale horizontal motion of air which is called wind. Weather is expressed by a combination of several elements. Here are lists of major elements and controls of weather and climate. The climate of a region is ultimately determined by the radiation, its distribution and temporal fluctuations. The long-term state of the atmosphere is a function of a variety of interacting elements.

Table 5.1.Elements and controls of weather and climate

Elements	Controls
1. Temperature	1 Latitude/angle of the Sun
2. Precipitation and humidity	2 Land and water distribution
3. Winds and air pressure	3 Winds and air pressure
	4 Altitude and mountain barriers
	5 Ocean currents

5.2.1. Controls of Weather and Climate

What do you think is the source of summer rainfall in Ethiopia? Have you ever noticed varying lengths of days and nights by seasons? What do you think is the reason behind?

The climate of any particular location on earth is determined by a combination of many interacting factors. These include latitude, elevation, nearby water, ocean currents, topography, vegetation, and prevailing winds. Moreover, the global climate system and any changes that occur within it also influence local climate.

Hotness or coldness, rainy or cloudiness, sunniness, windiness or calmness, of air you are feeling on the daily base in your current location are expressions of weather. Now the question one should inquire here is what determines the variations in weather and climate between places and

seasons. Hence, these determining factors are called *controls of weather and climate or climatic controls.* Some of the major controls are discussed below.

a. Latitude

Latitude is the distance of a location from the equator. The sun shines directly on equator for more hours during the year than anywhere else. As you move further away from the equator towards the poles, less solar insolation is received during the year and the temperature become colder. Ethiopia's latitudinal location has bearings on its temperature.

Latitudinal location of Ethiopia and the Horn resulted in;

- *high average temperatures,*
- *high daily and small annual ranges of temperature,*
- *no significant variation in length of day and night between summer and winter.*

b. Inclination of the Earth's Axis

The earth's rotation axis makes an angle of about 66 ½ ° with the plane of its orbit around the sun, or about 23 ½ ° from the perpendicular to the ecliptic plane. This inclination determines the location of the Tropics of Cancer, Capricorn and the Arctic and Antarctic Circles. As the earth revolves around the sun, this inclination produces a change in the directness of the sun's rays; which in turn causes the directness of the sun and differences in length of day and seasons.

Equinoxes and Solstices

An ***equinox*** is the instant of time when the sun strikes the plane of the Earth's equator. During this passage the length of day and night are equal. Moreover, revolution of the earth along its orbit, the inclination of its axis from the plane of that orbit, and the constant position (parallelism) of the axis causes seasonal changes in the daylight and darkness periods. Equinox appears twice a year. Let's see two major equinoxes';

- ***The Vernal (spring) equinox*:** is the day when the point of verticality of sun's rays crosses the equator northwards. This equinox experiences in Northern Hemisphere when the sun is exactly above the equator. During this period, the length of day and night are equal. Vernal *(spring)* equinox marks the beginning of spring season. March 21 marks the offset of the vernal equinox.

- ***The Autumn equinox:*** appears to happen when the sun crosses equator giving approximately equal length between day and night. It appears to happen when the visible sun moves south across the celestial equator on 23rd of September. It marks the beginning of Autumn season.

Solstice is an event when the overhead sun appears to cross northern or southern points relative to the celestial equator resulting in unequal length of days and nights in the hemispheres. Both hemispheres during this event has either the most or least sunlight of the year.

- ***The summer Solstice:*** on June 21st, the northern hemisphere has maximum tilt towards the sun experiencing longest daylight of the year. It is the astronomical first day of summer in the Northern Hemisphere. The sun is at its highest position in the noonday sky, directly above 23 ½ in the Tropic of Cancer.
- ***The winter solstice*****:** 22nd of December is the day when the maximum southward inclination is attained in the Southern Hemisphere. In this event the sun travels shortest length causing longest night and shortest daylight. In the Northern Hemisphere, it occurs when the sun is directly over the Tropic of Capricorn, which is located at 23 ½ ° south of the equator.

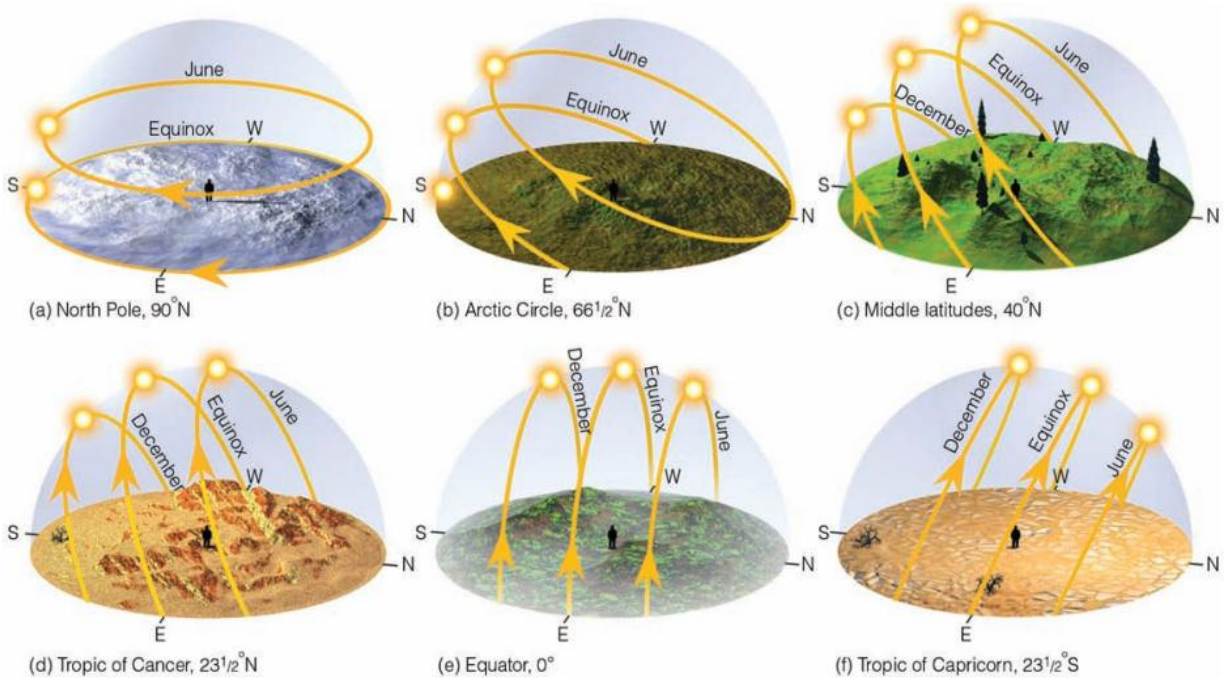


Figure 5.1. The apparent path of the sun at different latitudes. *Source:* ***Ahrens*** & ***Henson, 2019***

*c. Altitud*e

Do you have any experience of visiting high elevation places? What differences have you felt between the lowest and highest elevations?

Altitude is the height of location above the sea level. Under normal conditions there is a general decrease in temperature with increasing elevation. The average rate at which temperature changes per unit of altitudinal change is known as ***lapse rate***. The lapse rate is limited to the lower layer of the atmosphere named as troposphere. The normal lapse rate is 6.5°C per kilometer rise in altitude.

Types of lapse rate

Three types of lapse rates are identified;

i. Dry adiabatic laps rate

The temperature changes occurring in the rising or subsiding air mass are not the result of additions of heat to, or withdrawals of heat from outside sources, but rather are the consequence of internal processes of expansion and contraction. This is known as adiabatic temperature change. An adiabatic lapse rate is the rate at which the temperature of an air parcel changes in response to the expansion or compression process associated with a change in altitude.

Vertical displacements of air are the major cause of adiabatic temperature changes. When air rises, it expands because there is less weight of air upon it. Thus, if a mass of dry air at sea level rises to an altitude of about 18,000ft (5486.22 meters), the pressure upon it is reduced by nearly half and consequently its volume is doubled. As long as the air in the parcel is unsaturated (the relative humidity is less than 100 percent), the rate of adiabatic cooling or warming remains constant.

More precisely, if the upward movement of air does not produce condensation, then the energy expended by expansion will cause the temperature of the mass to fall at the constant *dry adiabatic lapse rate.* The rate of heating or cooling is about 10°C for every 1000 m of change in elevation. This rate applies only to unsaturated air, and thus it is called the *dry adiabatic laps rate.*

ii. Wet Adiabatic laps rate

Due to the fact that the heat added during condensation starts cooling following the expansion, the air will no longer cool at the dry adiabatic rate. This is due to the latent heat in the water vapor carried by the air. The heat is released in the process of ascent, therefore affecting or lowering the rate of temperature change of the rising air. If a saturated air containing water droplets were to sink, it would compress and warm at the moist adiabatic rate because evaporation of the liquid droplets would start the rate of compressional warming.

Hence, the rate at which rising or sinking saturated air changes its temperature is less than the dry adiabatic rate. Prolonged cooling of air invariably produces condensation, thereby liberating latent heat. Therefore, rising and saturated or precipitating air cools at a slower rate than air that is unsaturated. This process is called wet adiabatic temperature change. The rate of cooling of wet air is approximately ***5^0c per 1000*** *meters ascend.*

iii. Environmental lapse rate or Atmospheric lapse late

This refers to the actual, observed change of temperature with altitude. The fact that air temperature is normally highest at low elevations next to the earth and decreases with altitude clearly indicates that most of the atmospheric heat is received directly from the earth's surface and only indirectly from the sun.

But the lower layer is warmer, not only because it is closest to the direct source of heat but also of its high density. It contains more water vapor and dust, which causes it to be a more efficient absorber of earth radiation than is the thinner, drier, cleaner air aloft.

This decrease in temperature upward from the earth's surface normally prevails throughout the lower atmosphere called troposphere. The principal exception to the rule is the cause of temperature inversions. The rate of change is ***6.5^0C/1000 meters.***

5.3. Spatiotemporal Patterns and Distribution of Temperature and Rainfall in Ethiopia

5.3.1. Spatiotemporal Distribution of Temperature

Altitude is an important element in determining temperature of Ethiopia and the Horn. Latitude, humidity and winds, with varying magnitude have also significant impacts on temperature conditions in Ethiopia.

The spatial distribution of temperature in Ethiopia is primarily determined by altitude and latitude. The location of Ethiopia at close proximity to equator, a zone of maximum insolation, resulted for every part of the country to experience overhead sun twice a year. However, in Ethiopia, as it is a highland country, tropical temperature conditions have no full spatial coverage. They are limited to the lowlands in the peripheries.

Away from the peripheries the land begins to rise gradually and considerably, culminating in peaks in various parts of the country. Thus temperature, as it is affected by altitude, decreases towards the interior highlands. Mean annual temperature varies from over 30 ^{0}Cin the tropical lowlands to less than 10^0c at very high altitudes.

The Bale Mountains are among highlands where lowest mean annual temperatures are recorded. The highest mean maximum temperature in the country is recorded in the Afar Depression. Moreover, lowlands of north-western, western and south-eastern Ethiopian experiences mean maximum temperatures of more than 30^0C.

Environmental influences have their own traditional expressions in Ethiopia and there are local terms denoting temperature zones as shown in the table below:

Table 1: Temperature versus Altitude

Altitude (meter)	***Mean annual Temp (^{0}C)***	***Description***	***Local Equivalent***
3,300 and above	*10 or less*	Cool	*Wurch*
2,300 - 3,300	*10 – 15*	Cool Temperate	*Dega*
1,500 - 2,300	*15 – 20*	Temperate	*Woina Dega*
500 - 1,500	*20 – 25*	Warm Temperate	*Kola*
below 500	*25 and above*	Hot	*Bereha*

Source: MoA, 2000

The temporal distribution of Ethiopian temperature is characterized by extremes. The major controls determining its distributions are latitude and cloud cover. However, some parts of the country enjoy a temperate climate. In the tropics, the daily range of temperature is higher and the annual range is small, whereas the reverse is true in the temperate latitudes. In Ethiopia, as in all places in the tropics, the air is frost free and changes in solar angles are small making intense solar radiation.

Ethiopia's daily temperatures are more extreme than its annual averages. Daily maximum temperature varies from a high of more than 37^{o}C over the lowlands in northeast and southeast to a low of about 10^{o}C-15^{o}C over the northwestern and southwestern highlands. The variation in the amount of solar radiation received daily is small throughout the year. As already explained, temperature is high during the daytime in some places, and is considerably reduced at night resulting maximum difference in the daily range.

But in the case of monthly averages, variation is minimal and the annual range of temperature is small. This holds true in both the highlands and lowlands. In Ethiopia and elsewhere in the Horn, temperature shows seasonal variations. For example, months from March to June in Ethiopia have records of highest temperatures. Conversely, low temperatures are recorded from November to February.

It is not easy to observe distinct variation in temperature between seasons as the sun is always high in the tropics. However, there is a slight temperature increase in summer. Southern part of Ethiopia receives highest records of temperature in *autumn* and *spring* following the relative shift of the sun; whereas in the northern part of the country, summer season is characterized by higher temperature.

It has to be noted that certain seasons should have special considerations. For instance, unlike other parts of Ethiopia, the *southern and southwestern highlands* experience reduced temperature. This is because the temperature and the amount of energy reaching the surface is directly related with the directness of the sun.

The direction of rain bearing winds (leeward or windward side) also determines the temperature variations in mountainous regions.

5.3.2. Spatiotemporal Distribution of Rainfall

Rainfall system in Ethiopia is characterized by complexities. To encompass the system, it needs an understanding of the position of Inter Tropical Convergence Zone (ITC), pressure cells, and Trade Winds. Thus, the rainfall system in Ethiopia is characterized by spatial and temporal variabilities.

Rainfall in Ethiopia is the result is influenced by the position of Intertropical Convergence Zone (ITCZ). The convergence of Northeast Trade winds and the Equatorial Westerlies forms the

ITCZ, which is a low-pressure *zone*. The inter-annual oscillation of the surface position of the ITCZ causes a variation in the Wind flow patterns over Ethiopia and the Horn. Following the position of the overhead sun, the ITCZ shifts north and south of the equator. As the shift takes place, equatorial westerlies from the south and southwest invade most parts of Ethiopia bringing moist winds.

However, these winds decrease the length of rainy seasons and magnitudes on the line of the shift**.** The shift takes place when the trade winds from the north retreat giving the space for equatorial westerlies. This development mainly happens in July in Ethiopia and the Horn causing variability and seasonality.

The ITCZ shifts towards south of equator (Tropic of Capricorn) in January. During this period, the Northeast Trade Winds carrying non-moisture-laden dominates the region. Afar and parts of Eritrean coastal areas experience rainfall in this period. Following the directness of the Sun in March and September around the equator, the ITCZ shifts towards equator. During this time, the central highlands, southeastern highlands and lowlands receives rainfall as the south easterlies bring moist winds.

Seasonal or Temporal Variabilities

What winds bring summer rainfall for Ethiopian highlands?

The rainfall is highly variable both in amount and distribution across regions and seasons. The seasonal and annual rainfall variations are results of the macro-scale pressure systems and monsoon flows which are related to the changes in the pressure systems discussed in the previous sections of this chapter. The temporal variabilities of rainfall are characterized by;

i. Summer (June, July, August)

From mid-June to mid-September, majority of Ethiopian regions, except lowlands in Afar and Southeast, receive rainfall during the summer season as the sun overheads north of the equator. High pressure cells develop on the Atlantic and Indian Oceans around the tropic of Capricorn although the Atlantic contributes a lot, the *Indian Ocean* is also source of rainfall. During this season, Ethiopia and the Horn come under the influence of the Equatorial Westerlies (Guinea monsoon) and Easterlies. Hence, the *Guinea monsoon* and the *South easterly* winds are responsible for the rain in this season.

ii. Autumn (September, October and November)

Autumn is the season of the year between summer and winter. The exact position of the ITCZ changes over the course of the year, oscillating across the equator. In autumn the ITCZ shifts towards the equator weakening the equatorial westerlies. During this season, the south easterlies from Indian Ocean showers the lowlands in southeastern part of Ethiopia.

iii. Winter (December, January and February)

In winter, the overhead sun is far south of equator. During this season, northeasterly winds originating from the landmass of Asia dominantly prevail Ethiopian landmass. However, it has no significant coverage compared to other seasons. The northeasterly winds crossing the Red Sea carry very little moisture and supplies rain only to the Afar lowlands and the Red Sea coastal areas.

iv. Spring (March, April and May)

In this season, the noonday sun is shining directly on the equator while shifting north from south. The shift of the ITCZ, results in longer days and more direct solar radiation providing warmer weather for the northern world. In this season, the effect of the northeast trade wind is very much reduced. Conversely, the southeasterlies from the Indian Ocean provide rain to the highlands of Somalia, and to the central and southeastern lowlands and highlands of Ethiopia**.**

Rainfall Regions of Ethiopia

Based on rainfall distribution, both in space and time, four rainfall regions can be identified in Ethiopia and the Horn. These are:

i. Summer rainfall region

This region comprises almost all parts of the country, except the southeastern and northeastern lowlands. The region experiences most of its rain during summer (kiremt), while some places also receive spring (Belg) rain. The region is divided in to dry and wet summer rainfall regions. Hence, the wet corresponds to the area having rainfall of *1,000 mm* or more. The High altitudes and the windward side experience such rainfall amount.

ii. All year-round rainfall region

It has many rainy days than any part of the country. It is a rainfall region in the southwestern part of the country. The wetness of this region is particularly due to the prepotency of moist air currents of equatorial Westerlies called the *Guinea Monsoons*. Both duration and amount of rainfall decreases as we move from southwest to north and eastwards. Months in summer gain highest rainfall whereas the winter months receive the reduced amount. The average rainfall in the region varies from *1,400* to over *2,200 mm/year*.

iii. Autumn and Spring rainfall regions

The region comprises areas receiving rain following the influence of *southeasterly* winds. *South eastern lowlands* of Ethiopia receive rain during autumn and spring seasons when both the north easterlies and equatorial westerlies are weak. The south-easterlies bring rainfall from the Indian Ocean. About *60 percent* of the rain is in autumn and *40 percent* in spring. The average rainfall varies from less than 500 to 1,000 mm.

iv. Winter rainfall region

This rainfall region receives rain from the northeasterly winds. During the winter season, the Red sea escarpments and some parts of the Afar region receive their main rain.

5.4 Agro-ecological Zones of Ethiopia

As a result of the diversified altitude and climatic conditions, Ethiopia possesses diverse agro-climatic zones. These zones have traditionally been defined in terms of temperature. This system divides the nation into five major climatic zones namely *Bereha, Kolla, Woina Dega, Dega* and *Wurch*. A description on each of the zones is presented as follows.

The Wurch Zone

The Wurch-zone is an area having altitude higher than 3,200 meters above sea level and mean annual temperature of less than 10^{o}C. Mountains having typically fitting characteristics of this zone include mountain systems of Ras Dashen, Guna, Megezez in North Shoa, Batu, Choke, Abune Yoseph etc.

Table 5.2: Agro Ecological Zones of Ethiopia

Zones	Altitude (m)	Mean annual rainfall (mm)	Length of growing periods (days)	Mean annual temperature (^{0}C)	Area share (%)
Wurch (cold to moist)	>3,200	900-2,200	211–365	Below 10	0.98
Dega (cool to humid)	2,300 - 3,200	900-1,200	121–210	≥11.5–17.5	9.94
Weyna Dega (cool sub humid)	1,500 - 2300	800-1,200	91–120	>17.5 – 20.0	26.75
Kola (Warm semiarid)	500 - 1,500	200-800	46–90	>20.0 – 27.5	52.94
Berha (Hot arid)	<500	Below 200	0–45	>27.5	9.39

Source: MoA,1998

Dega Zone

This is a zone of highlands having relatively higher temperature and lower altitude compared to the *wurch* Zones. In Ethiopia, the Dega-zone is long inhabited and has dense human settlement due to reliable rainfall for agriculture and absence of vector-borne diseases such as malaria.

Weyna Dega Zone

This zone has warmer temperature and moderate rainfall. It lies between 1500-2,300 meters above sea level. It is the second largest zone covering more than 26% of the landmass of Ethiopia. The temperature and rainfall of this category is highly suitable for majority of crops grown in Ethiopia. Hence, the zone includes most of the agricultural land. The *Weyna Dega* zone has also two growing seasons.

Kolla Zone

In Ethiopia, the geographic peripheries in south, southeast, west and northeastern part are mainly in this category. Kolla is the climate of the hot lowlands with an altitudinal range of 500 to 1500 meters above sea level. Average annual temperature ranges between 20^{o}C and 30^{o}C. Although mean annual rainfall is erratic, it can be as high as 1500 mm in the wet western lowlands of Gambella. Rainfall is highly variable from year to year. The region is boundary between the hot arid (Bereha) and the humid climates (Woina Dega).

Bereha Zone

Bereha is the hot arid climate of the desert lowlands. The Bereha agro-climatic zone is largely confined to lowland areas with altitude of lower than 500 meters. Around Danakil depression,

the elevation goes below the sea level. Its average annual rainfall is less than 200 mm, and average annual temperature is over 27.5^{o}C. Strong wind, high temperature, low relative humidity, and little cloud cover usually characterize Bereha. Evapotranspiration is always in excess of rainfall. Djibouti, majority of Somalia, and coastal areas of Eritrea are categorized under Kolla and Bereha zones.

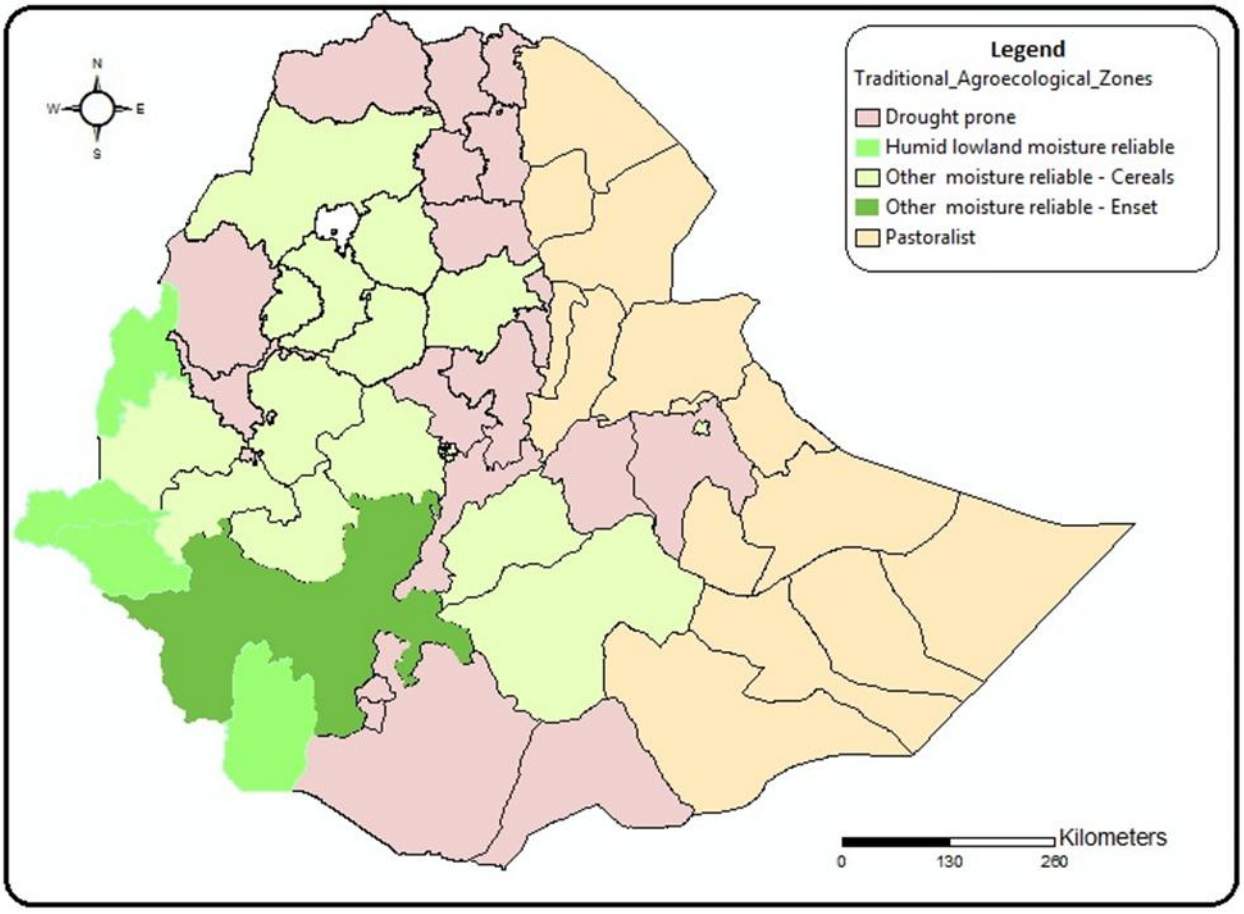


Figure 5.2. Traditional Agro Ecological Zones of Ethiopia.

5.5. Climate Change/Global Warming: Causes, Consequences and Response Mechanisms

Climate change is natural and has always been there. So why is it our concern now?

Climate change refers to a change in the state of the climate that can be identified (e.g. using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, due to either natural variability or human activities.

In this section of this chapter the concept of climate change, causes, consequences and response mechanisms in relation to the Ethiopia's past, present and future situations will be discussed.

5.5.1. Current Trends of Climate in Ethiopia

Besides spatial and temporal variations in different parts of the country, Ethiopian climate experiences extremes such as drought, flood etc. Ethiopia ranked 5th out of 184 countries in terms of its risk of drought. In the country, 12 extreme drought events were recorded between 1900 and 2010. Among the 12, seven of the drought events occurred since 1980. The majority of these resulted in famines. The severe drought of 2015-2016 was exacerbated by the strongest El Nino that caused successive harvest failures and widespread livestock deaths in some regions.

Trends in Temperature Variability

Over the last decades, Ethiopia has experienced climatic changes. Mean annual *temperature* has shown 0.2°C to 0.28°C rise per decade over the last 40-50 years. *A rise in average temperature of about 1.3°C has been observed between 1960 and 2006.* The rise has spatial and temporal variation. Higher rise in temperature was noted in drier areas in northeast and southeast part of the country. Notably the variability is higher in July-September. The number of 'hot days' and 'hot nights' has also shown increment. Consequently, the country's minimum temperature has increased with 0.37°C to 0.4°C per decade.

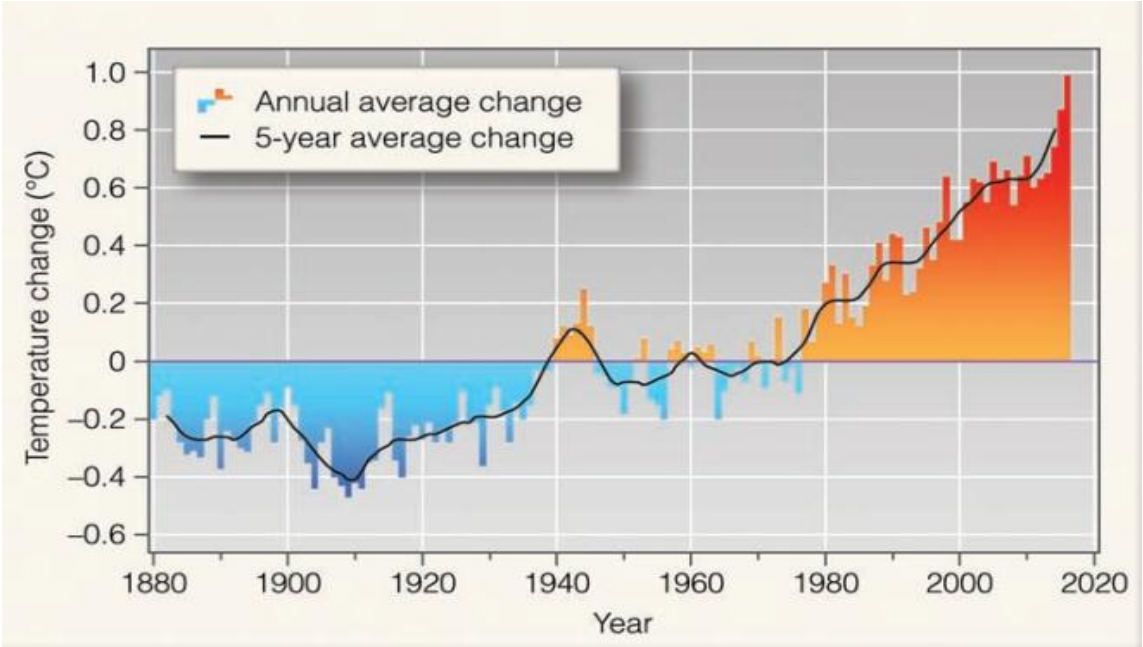


Figure 5.4: Global mean temperature anomaly. Orange (land) and blue (sea)

Source: Meteorology Today, 2019

Trends in Rainfall Variability

Precipitation has remained fairly stable over the last 50 years when averaged over the country. However, these averages do not reflect local conditions which are extremely divergent and the natural variability in rainfall in the country makes it difficult to detect long-term trends.

Rainfall variability is increasing (and predictability is decreasing) in many parts of the country. In some regions, total average rainfall is showing decline. For instance, parts of southern, south-western and south-eastern regions receiving Spring and Summer rainfall have shown decline by 15-20% between 1975 and 2010. This has strong implications for crop production, which becomes clear when assessing the change in areas that receive sufficient rain to support crop production.

Changes in temperature and rainfall increase the frequency and severity of extreme events. Major floods have been a common occurrence, leading to loss of life and property in numerous parts of the country. Warming has exacerbated droughts, and desertification in the lowlands of the country is expanding.

5.5.2. Causes of Climate Change

The causes of climate change are generally categorized as anthropogenic/manmade and natural causes.

A. *Natural Causes*

Climate change has many natural causes, such as variations in the energy budget, the position of Earth relative to Sun, the position of continents relative to the equator, and even whether the continents are together or apart. Here are some of the major natural causes:

- ***Earth orbital changes***: The earth is tilted at an angle of 23.5° to the perpendicular plane of its orbital path. Changes in the tilt of the earth can lead to small but climatically important changes in the strength of the seasons. More tilt means warmer summers and colder winters.
- ***Energy Budget:*** Although the Sun's energy output appears constant, small changes over an extended period of time can lead to climate changes. Since the Sun was born, 4.5 billion years ago, the star has been very gradually increasing its amount of radiation so that it is now 20% to 30% more intense than it was once.
- ***Volcanic eruptions****:* volcanic eruption releases large volumes of sulphur dioxide, carbon dioxide, water vapor, dust, and ash into the atmosphere. The release of large volume of gases and ash can increase planetary reflectivity causing atmospheric cooling.

B. Anthropogenic Causes

The growing influence of human activities on the environment is being increasingly recognized, and concern over the potential for global warming caused by such anthropogenic effects is growing. The warming of earth planet in the past 50 years is majorly driven by human activities.

The industrial activities that our modern civilization depends upon have raised atmospheric carbon dioxide levels from 280 parts per million to 400 parts per million in the last 150 years. Human induced greenhouse gases such as carbon dioxide, methane and nitrous oxide have caused much of the observed increase in Earth's temperatures over the past 50 years.

The decomposition of wastes in landfills, agriculture, ruminant digestion and manure management, synthetic compounds manufacturing, clearing of land for agriculture, industrial activities, and other human activities have increased concentrations of greenhouse gases. The

major gases that contribute to the greenhouse effect include *Water vapor, Carbon dioxide (CO_2), Methane, Nitrous oxide, Chlorofluorocarbons (CFCs).*Although methane is less abundant in atmosphere, it is by far more active greenhouse gas than carbon dioxide.

5.5.3. Consequences of Climate Change

In many parts of the world, climate change has already caused loss of life, damaging property and affecting livelihoods. The impact of climate change is higher in low income countries, since they have limited capacity to cope with the changes. Some of the consequences of the changing climate include:

- **Impacts on human health**: The change can cause increased heat related mortality and morbidity, greater frequency of infectious disease epidemics following floods and storms, and substantial health effects following population displacement to escape extreme weather events. Climate change also raises the incidence malaria.
- **Impact on water resources***:* Climate change is leading to melting of snow and glaciers that increases rise in sea level, increase drought and floods, distorts wind flow pattern, decreases water table. More frequent and longer droughts reduce the amount of run-off into rivers, streams and lakes.

- **Impact on Agriculture**: changes in temperature and rainfall patterns as well as significantly affect agricultural production. Climate change increases physiological stress and fodder quality and availability.

- ***Impact on Ecosystem:*** climate change affects the success of species, population, and community adaptation. The rate of climatic warming may exceed the rate of shifts in certain range species, these species could be seriously affected or even disappear because they are unable to resist.

5.5.4. Climate Response Mechanisms

How do our forefathers react to the changing climate? Do we have any traditional (indigenous) mechanism?

Climate change is one of the most complex issues facing us today. So even if we stopped emitting all greenhouse gases today, global warming and climate change will continue as it has

natural source of emission. Hence, there has to be response mechanism to reduce the impact of extreme events. There are three major response mechanisms to climate change namely *mitigation, adaptation and resilience.*

Mitigation and its Strategies

Mitigation measures are those actions that are taken to reduce and control greenhouse gas emissions changing the climate. Moreover, it implies reducing the flow of heat trapping greenhouse gases into the atmosphere, either by reducing sources of these gases or enhancing the "sinks" that accumulate and store these gases(such as the oceans, forests and soil).The goal of mitigations is to avoid significant human interference with the climate system. There are some mitigation measures that can be taken to avoid the increase of pollutant emissions.

- Practice Energy efficiency
- Increase the use of renewable energy such as solar
- Efficient means of transport implementation: electric public transport, bicycle, shared cars etc.

Adaptation and its Strategies

Throughout history, people and societies have adjusted to and coped with changes in climate and extremes with varying degrees of success. Adaptation is simply defined as adapting to life in a changing climate. It involves adjusting to actual or expected future climate. The goal is to reduce our vulnerability to the harmful effects of climate change such as extreme weather events or food insecurity. It also encompasses making the most of any potential beneficial opportunities associated with climate change (for example, longer growing seasons or increased yields in some regions).

Some of the major adaptation strategies include:

- building flood defenses,
- plan for heatwaves and higher temperatures,
- installing water-permeable pavements to better deal with floods and storm water
- improve water storage and use are some of measures taken by cities and towns.
- landscape restoration and reforestation,
- flexible and diverse cultivation to be prepared for natural catastrophes
- preventive and precautionary measures (evacuation plans, health issues, etc.)

Check!

1. Differentiate between weather and climate.
2. Which control of weather and climate predominantly affect Ethiopian climate? How?
3. Discuss spatiotemporal distribution of temperature and rainfall in Ethiopia.
4. Do we have dynamics in temperature and rainfall in Ethiopia? Is it warming or cooling?
5. What causes climate change?
6. How can we respond to the changing climate?

CHAPTER SIX

SOILS, NATURAL VEGETATION AND WILDLIFE RESOURCES OF ETHIOPIA AND THE HORN

6.1. Introduction

The past geological process and varied climatic events ensued Ethiopia to have varied soil and biological diversity. The formation and spatial variabilities of soils in Ethiopia is largely related to topographic and climatic factors, parent material (rocks) and land use. Different parts of Ethiopian regions experiences. Likewise, the distribution of wildlife and natural vegetation in Ethiopia and the Horn is controlled by many factors important among which are *climate, soil types, drainage*, etc. Natural vegetations are vital for human beings in many ways. Plants can provide shelter, food, source of fuel, pasture and grazing, raw material for industries. Ethiopia possess unique and characteristic fauna and flora with a high level of endemicity. However, manmade as well as natural problems are threatening their availability and distribution.

Objectives

At the end of this chapter you will be able to;

- Identify major soil types of Ethiopia
- Understand soil degradation and conservation measures
- Describe the distribution of natural vegetations in Ethiopia
- Explain the significance of wildlife resources of Ethiopia

6.2. Ethiopian Soils: Types, Degradation and Conservation

How does your local community identify and name soils?

How sever is erosion in your locality? Do you know the causes for its degradation?

6.2.1. Introduction

Soil is a delicate but highly varied composition of mineral particles, organic matter and living organisms in dynamic equilibrium. This variability reflects primarily the parent material from which the soil was formed over very long periods of time and the environment in which the soil

has developed. *It consists of* weathered mineral materials (45%), organic matter (5%), air (20-30%) and water (20-30%).

Soil formation is a long-term process. It could take several thousands of years to form a single stratum of soil. As it is a complex mixture of several constituents, its formation is also more complex. The formation of a particular type of soil depends on parent material, climate, topography, living organism and time.

Weathering disintegrates the inorganic substances (rocks) of soils. It is the breakdown of rocks at the Earth's surface, by the action of rainwater, extremes of temperature, and biological activity. There are three types of weathering involving in soil formation. These are:

A. Mechanical (physical) weathering

Physical disintegration causes decrease in size without appreciably altering composition. Differential stresses due to heating and cooling or expansion of ice break the rock. Abrasion (erosion by friction) due to water containing sediment or wind carrying debris is another type of physical weathering.

B. Biological weathering

The process of biological weathering involves the weakening and subsequent disintegration of rock by plants, animals and microbes. Roots of plant can exert pressure on rock. Although the process is physical, the pressure is exerted by a biological process (*i.e.*, growing roots). Microbial activity breaks down rock minerals by altering the rock's chemical composition, thus making it more susceptible to weathering.

***C.* Chemical weathering**

Chemical weathering involves the modification of the chemical and mineralogical composition of the weathered material. A number of different processes can result in chemical weathering. The most common chemical weathering processes are hydrolysis, oxidation, reduction, hydration, carbonation, and solution.

In most cases, the minerals in the parent materials are also found in the soils, which are formed from the disintegration and decomposition of the rock. However, this is not true of alluvial soils, which are transported from one place to the other by agents like running water.
Soils have two basic properties:

Physical properties

Soil physical properties are influenced by composition and proportion of major soil components. Properties such as texture, structure, porosity etc. are categorized under physical soil properties. These properties affect air and water movement in the soil, and thus the soil's ability to function.

Chemical Properties

Soil chemistry is the interaction of various chemical constituents that takes place among soil particles and in the water retained by soil. Soil properties like availability of minerals, electrical conductivity, soil pH, etc. Soil chemical properties affect soil biological activity and indirectly the nutrient dynamics.

6.2.2. Major Soil Types in Ethiopia

Soils of Ethiopia are basically derived from *crystalline, volcanic and Mesozoic* sedimentary *rocks.* One can therefore, say that some of the soil divisions in the country are based on the geologic structure. However, it should be born in mind that, there are soils formed due to long waited deposition of sediments.

FAO has identified 18 soil associations in Ethiopia at scale of 1:2,000,000. Out of the major soils, 11 soil associations cover about 87.4 percent of the land area. The *six major groups of soils* in Ethiopia are discussed under the following points:

A. *Environmental condition* i.e. parent material, climatic conditions, topography, the way they were formed.
B. *Characteristic* i.e. significant chemical and physical properties.
C. *Agricultural suitability* in relation to texture, structure, topography, moisture-storage capacity, etc.
D. *Occurrence*: general location of the soil types.

1. Nitosols and Acrisols

Nitosols develop on gently sloping ground. Their parent materials *include trap series volcanics, volcanic ash, and even metamorphic rocks*. They are strongly weathered soils but far more productive than most other tropical soils. They are basically associated with highlands with high rainfall and they were, probably, formed on forest covered areas originally.

Due to the high rainfall, there is considerable soil leaching which makes the ***nitosols*** to be poor in soluble minerals like potassium, calcium etc.; and rich in non-soluble minerals like iron and aluminum. The reddish-brown color of these soils is because of high concentration of *iron (ferric) oxides* due to leaching. But they are now widely found on cultivated areas and on mountain grasslands. ***Nitosols*** are dominantly found in western highlands *(Wellega),* southwestern highlands (*Kaffa, Illuababora*), Southern highlands, Central highlands, and Eastern highlands.

Acrisols are one of the most inherently infertile soils of the tropics, becoming degraded chemically and organically very quickly when utilized. Acrisols have very low resilience to degradation and moderate sensitivity to yield decline. In Ethiopia, it has lost most of the base nutrients and are characterized by low productive capacity. ***Acrisols*** are found along with *nitosols* mostly in some pockets of southwestern highlands of Ethiopia where there is high rainfall.

2. *Vertisols*

Vertisols are heavy clay soils with a high proportion of swelling clays when wet, and cracks when dry. These soils are extremely difficult to manage (hence easily degraded), but has very high natural chemical fertility. Vertisols mostly develop on *volcanic plateau basalt, trachyte* and *pyroclastic materials, sedimentary rocks, colluvial slopes* and *alluvial plains*. The vertisols are also soils of highlands and moderate climates. In Ethiopia, they are commonly found in parts of *Northwestern, Central and Southeastern highlands* (especially in *Gojjam, Shewa, Arsi, Bale* and *central Hararghe*).

3. *Lithosols, Cambisols and Regosol*

These soils are mostly found in rugged topography and steep slopes. There is little evidence of *pedogenic processes* (soil forming processes). As a result, they are young, shallow and coarse

textured and so have low water holding capacity. In addition, they are found in areas of low rainfall. So, most of the areas covered by these soils have limited agricultural use. They are, in most cases, left under the natural plant cover and used for grazing.

By and large, these soils are found in different parts of rugged and steep slopes of Central Highlands, on the *Rift Valley Escarpments* and *highlands in of western Hararghe*. Regosol and Lithosols are also found in the Danakil and eastern Ogaden.

4. *Xerosols, Yermosols and Solanchaks*

These are soils of desert or dry steppe soils majorly available in arid and semiarid areas. Though the degree may vary, desert soils are characterized by high salt content and low organic content, because of the scanty vegetation. Generally speaking, these soils have poor humus content and nitrogen, but are rich in phosphorus and potash and can be very fertile if irrigated.

Xerosols are soils of the deserts, has low organic content. These soils are extremely subjected to wind erosion and concentration of soluble salts. Yermosols are even drier and more problematic than Xerosols. Solanchaks are saline soils which develop in areas of high evaporation and capillary action. Badly managed irrigation schemes may turn soils into solonchaks.

In Ethiopia, Xerosols are found in Ogaden and northeastern escarpments, whereas the Yermosols and Solonchaks cover the Ogaden and Afar plains. The Solonchaks are majorly located in salty plains of Afar.

5. *Fluvisols*

Fluvisols develop on flat or nearly flat ground, on recent alluvial deposits. These soils are associated with *fluvial (river), marine (sea) and lacustine (lake*) deposits.

These are soils formed due to deposition of eroded materials from highlands. The deposition takes place in depressions, lower valleys and lowlands. Lower regions of rivers like Omo, Awash, Abay and the plains of Akobo and Baro Rivers are home for fluvivsols. Lakes region (main Ethiopian rift) is also characterized by fluvisols.

Fluvisols are highly variable, but much prized for intensive agriculture because:

- they develop on flat ground, deposition sites,

- they are associated with rivers and ground water, making them important for large-scale irrigation and
- they are fertile and their fertility is always renewed as a result of deposition of new soil materials.

6. *Luvisols*

Luvisols develop mainly in areas where pronounced wet and dry seasons occur in alternation. Where leaching is not very high, they are found in association with nitosols. Luvisols have good chemical nutrients and they are among the best agricultural soils in the tropics. So, they are intensively cultivated. However, when luvisols are found on steep slopes (stony) and on flat areas (waterlogged) they are avoided and left for grazing. In Ethiopia, places with luvisols include *Lake Tana* area, parts of Northern, Central and Eastern Highlands and Southern lowlands.

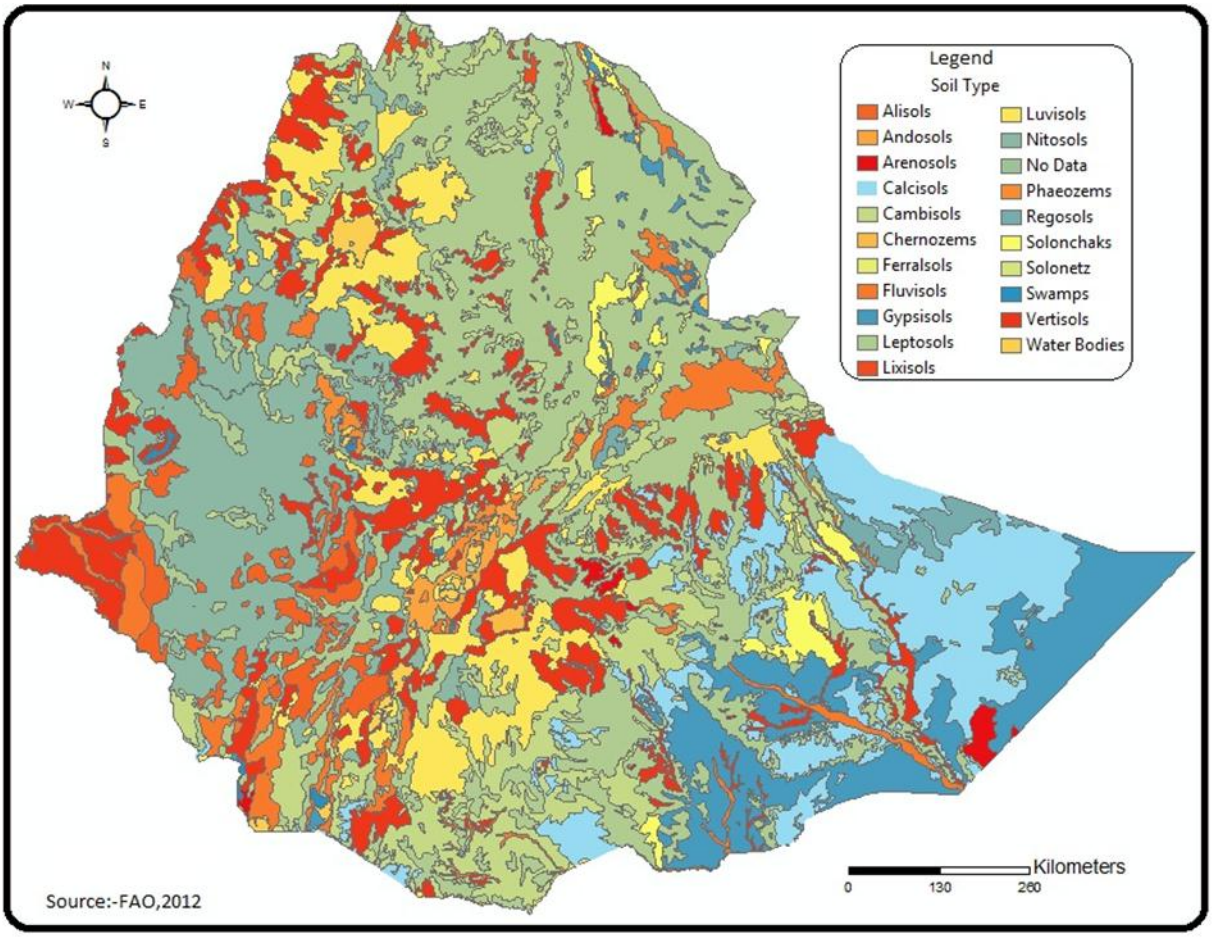


Figure 6.1. Soil types of Ethiopia

6.2.2. Soil Degradation

Soil degradation is defined as a change in any or all of soil status resulting in a diminished capacity of the ecosystem to provide goods and services. It could also be the deterioration of the physical, chemical and biological properties of soil. It is a critical and growing global problem. It is a major concern for at least two reasons. First, soil degradation undermines the productive capacity of an ecosystem. Second, it affects global climate through alterations in water and energy balances and disruptions in cycles of carbon, nitrogen, sulfur, and other elements.

There are three major types of soil degradation. These are:

i. **Physical Degradation:** refers to the deterioration of the physical properties of soil. This includes:

A. ***Compaction:*** densification of soil is caused by the elimination or reduction of structural pores. Soils prone to compaction are susceptible to accelerated runoff and erosion.

B. ***Soil erosion:*** is a three-phase process consisting of the *detachment of individual soil particles,* transportation *and deposition.* The continuous strike of soil surface by rain droplets considerably weakness the soil and makes susceptible to erosion. When sufficient amount of water accumulates, the soil will begin to move towards lower slope until the erosive agent loses its energy. Erosion of topsoil by wind and water exceeds soil formation at an alarming rate. Obviously for countries like Ethiopia where agriculture plays the dominant role in the economy and livelihood of the people, the causes, consequences and possible ways of minimizing soil erosion require serious consideration. In Ethiopia, an estimated average of 42 tons per hectare of soils is eroded annually.

ii. **Biological Degradation**

Reduction in soil organic matter content, decline in biomass carbon, and decrease in activity and diversity of soil fauna are ramifications of biological degradation. Because of prevailing high soil and air temperatures, biological degradation of soil is more severe in the tropics than in the temperate zone. It can also be caused by indiscriminate and excessive use of chemicals and soil pollutants.

iii. Chemical Degradation

Nutrient depletion is a major cause of chemical degradation. In addition, excessive leaching of cat-ions in soils with low-activity clays causes a decline in soil pH and a reduction in base saturation. Chemical degradation is also caused by the buildup of some toxic chemicals and an elemental imbalance that is injurious to plant growth.

Causes of soil degradation

Soil degradation may result from natural and human-induced causes. Topographic and climatic factors such as steep slopes, frequent floods and tornadoes, storms and high-velocity wind, high-intensity rains and drought in dry regions are among the natural causes. Deforestation and overexploitation of vegetation, overgrazing, indiscriminate use of agrochemicals and lack of soil conservation practices, and over extraction of ground water are some anthropogenic causes of soil degradation.

6.2.3. Soil Erosion Control Measures

The aim of soil conservation is to reduce erosion to a level at which the maximum sustainable level of agricultural production, grazing or recreational activity can be obtained from an area of land without unacceptable environmental damage. Since erosion is a natural process, it cannot be prevented. But it can be reduced to a maximum acceptable level or soil loss tolerance.

We have two major soil erosion control mechanisms. These are:

A. Biological Control measures

These types of soil erosion control mechanisms include vegetative strips, plantation, and reforestation. Biological controls can prevent splash erosion, reduces the velocity of surface runoff, increases surface roughness which reduces runoff and increases infiltration, and etc.

B. Physical control measures

Physical measures are used to control the movement of water and wind over the soil surface. The major types of physical erosion control measures commonly applied in Ethiopia includes terracing, check dams, gabion, trenches, contour ploughing, soil bunds etc.

6.3. Natural Vegetation of Ethiopia

6.3.1. Introduction

Natural vegetation refers to a plant cover that develops with little or no human interference. It can also be seen as any original plant cover grown in an area. Its distribution on the surface of the earth is uneven majorly controlled by factors such as *climate, soil types, drainage*, etc. However, to a large extent, temperature and precipitation affect the spatial distribution and the original plant cover of a region. That is why, more than any other single element, the natural vegetation of an area becomes a very good indicator of the climatic conditions.

Natural vegetations are vital for human beings in many ways. Plants can provide shelter, food, source of fuel, pasture and grazing, raw material for industries, source of timber and non-timber products. The other uses include moderating effect on local climate, as home of wild life, medicinal values, minimizing soil erosion etc.

The characteristics of Ethiopia's natural vegetation are to a large extent determined by elevation (and temperature) and rainfall. In Ethiopia, since temperature is mostly controlled by elevation, the spatial distribution of natural vegetation in the country is strongly correlated to it. Lowlands due to their low rainfall and high temperature have harsh environment and are characterized by *xeromorphic* plants (plants which are adapted to drought and high temperatures). Highlands (up to about *3000* m) are cooler than the lowlands and where there is adequate moisture a variety of forests can be seen. Plants whose growth is limited by the low temperature characterize high altitude areas (mostly above *3000* m). Ethiopia possesses an estimated number of 6000 species of higher plants of which 10% are endemic.

6.3.2. Major Natural Vegetation Types of Ethiopia

Taking altitude into consideration it is possible to broadly classify the vegetation belts of Ethiopia into the following five groups.

1. ***Afro-alpine and sub-afro alpine Region***
2. ***Forest Region***
3. ***Woodland Savannah Region***
4. ***Steppe Region***
5. ***Semi-desert Region***

1. Afro-alpine and Sub-afro alpine Region

Ethiopia has the largest extent of Afro-alpine and sub afro-alpine habitats in Africa. This vegetation type, also known as high mountain vegetation is similar to the Alpine vegetation in temperate regions. These ecosystems are found on mountains having an elevation ranging between 3,200 and 4,620 meters above sea level. The Afro-alpine habitat covers nearly 1.3% of the total landmass of Ethiopia.

The Afro-alpine region is found at very high altitudes (4,000 – 4,620 m). Like any other landform in Ethiopian, the climate of Afro-alpine ecosystems is controlled by latitude and altitude. The annul precipitation which ranges between 800 and 1,500 mm, is mostly in the form of sleet or snow. Temperature records of 0^{o}C and below are widely experienced in these ecosystems. Soils in this ecosystem are mostly shallow and eroded. The Bale and Semein mountains are typical examples of afro-alpine vegetations.

Compared to the Afro-alpine, the **Sub-afro-alpine** region is found at a lower elevation, roughly between 3,300 and 4,000 meters. As a result, the plants in this region are adapted to somewhat less extreme environment than the **Afro-alpine**.

Vegetation in the Afro-alpine region consists of tussock grasslands, scrub, scattered mosses and lichens while the Sub-afro alpine region is dominated by woodland, often degraded to scrub stages and also wet grasslands. *Lobelia rhynchopetalum* (giberra) and *Erica arborea* (Asta) are some of the dominant species in the Afro-alpine and Sub-afro alpine regions respectively.

2. Forest Region

Forest is a complex ecosystem consisting predominantly of trees that shield earth and support numerous life forms. Not all forests are similar in terms of species composition, structure and physiognomy. In any geographical region, environmental factors such as climate, soil types, topography and elevation determine the types of forests.

In Ethiopia, forests are found at different elevations, 450 to 3,500m in humid parts and 2,300 to 3,300 m in most arid parts. Moreover, forests are characterized by variation in mean annual rainfall that range between 200 and 2,200mm. These wide variations in rainfall and altitude result in two broad classification of forests: Highlands and Lowland forests. Highland forests include Hagenia Abyssinia (*Kosso*), Juniper procera (*tid*), Arundinaria Alpina(*kerkha*), Podocarpus falcatus (*zigba*), Aningeria adolfi-friedericii (*keraro*) and Olea africana (*Weyra*)

forests; while Baphia are classified as lowland forests. Moreover, there are also *Gallery (Riverine) Forests***.** These are forests that stretch along the banks of the lower courses of rivers. Riverine forests are classified as lowland forests and are found in some places such as the banks of Awash, Wabishebelle, Ghenale etc. Dominant species include Ficus sur (*sholla*) and different kinds of acacia trees.

3. **Woodland Savannah Region**

Like the forests, the woodland savannahs are also found in areas of wide altitudinal ranges (250 to 2,300 m). Although the mean annual rainfall ranges between 200 and 1,400 mm, the large part of this region is found at a lower elevation and in a drier environment. The plants in the woodland savannah are known for their xeromorphic characteristics like shading of leaves during the dry season. Vegetation types with intermediate characteristics between savannahs and woodlands are shrublands and bushlands. Woodland savannah region can be broadly classified into three divisions:

- ***Juniper procera*** *(tid)* is dominant species for both the Junipers Forests and Junipers Woodlands. The difference is in height: *3 - 45* meters tall in the forests and *10 -15* meters in the woodlands.
- ***Acacia woodlands*** are dominated by both trees and shrubs, which belong to the same genus 'Acacia'. E.g. **Acacia etbaica*(grar*),Acacia mellifera** (*Konter*).
- ***Mixed deciduous woodlands***: As the name implies, most of the trees in ***mixed deciduous woodlands*** shed their leaves during the dry season.

Table 6.1: Woodland Savanna Region

Woodland savanna type	**Altitude(m)**	**MeanAnnual RF (mm)**	**Growing season(No. of months)**	**Dominant species**
Junipers woodland	1,350-2,200	500-900	4-8	Junipers procera
Acacia woodland	250-2,300	200-1,000	1-9	Acaci aetabica(Grar)
Mixed deciduous woodland	300-1,300	800-1.400	5-12	Mixed trees

4. ***Steppe and Semi Desert Regions***

These are regions in the arid and semiarid parts of the country where the temperature is very high and the rainfall very low. Both are found at low elevations, the steppe at elevations of *100* to *1,400* m above sea level and the semi-deserts at *130 meters* below sea level to 600 meters above sea level.

The steppe gets a mean annual rainfall of 100 to *550* mm as compared to *50* to *300* mm for the semi desert areas. Growing period lasts up to 2 months for the steppe and a maximum of one month for the semi-deserts. Even though there is a variation in the degree of alkalinity and salinity; soils in both regions are generally alkaline and saline.

In these regions xerophytic (i.e. drought-resisting plants) are the dominant vegetations. Xerophytic plants such as short shrubs, scattered tufts of grass species and a variety of acacias are some of the examples. Where there are moist soils, rich vegetation of acacia and palm trees may be observed. Trees are normally restricted to fringes along watercourses.

6.3.3. Natural vegetation Degradation

Over the past century, a rapid growth of the already dense Ethiopian population has led to overexploitation of the land. In areas with settled agriculture, new land has been cleared at the expense of forests. Ethiopia's forest resources have been disappearing at an alarming rate. A century ago, forests covered about 40 percent of the total land area. For the last few decades, forests have been cleared for different reasons. Major causes for the gradual disappearance of the natural vegetation in Ethiopia are:

- Clearing of forests for cultivation
- Timber exploitation practices
- Charcoal burning and cutting for fuel
- Extensions of coffee and tea production areas
- Overgrazing
- Expansion of settlements both rural and urban, and clearing for construction.

6.3.2. Natural Vegetation Conservation

Conservation of biodiversity is protection and management of biodiversity so as to maintain at least its current status and derive sustainable benefits for the present and future generation. There

is an urgent need of conservation of the ever-degrading biodiversity. There are three main approaches of biodiversity conservation:

- ***Protection:*** through designation and management of some form of protected area. Protected areas include sanctuaries, national parks, and community conservation areas.
- ***Sustainable forest management:*** involving sustainable harvesting of forest products to provide a source of financial income
- ***Restoration or rehabilitation:*** is the process of assisting the recovery of a forest ecosystem that has been degraded, damaged, or destroyed. This may involve the re-establishment of the characteristics of a forest ecosystem, such as composition, structure, and function, which were prevalent before its degradation.

6.4. Wild Life/wild animals in Ethiopia

6.4.1. Introduction

Ethiopia is one of the few countries in the world, which possess unique and characteristic fauna with a high level of endemicity. Existence of wide range of ecosystems endowed Ethiopia with great varieties of habitats contributing for the occurrence of high faunal diversity. However, data on faunal resource of the country is as a whole is limited to mammals, birds, reptiles, amphibians and a few groups of arthropods.

Ethiopia has about 860 avian species (16 endemic species and two endemic genera), 279 species of mammals (31 endemic species and six endemic genera), 201 species of reptiles (14 endemic species), 23 species of amphibians (23 endemic species), and 150 freshwater fish (6 endemic species).

A total of 279 mammalian species of which 31 are endemic are known to occur in Ethiopia including those that require urgent conservation action i.e. Walia Ibex (Capra walie), Gelada Baboon (Theropithecus gelada), Mountain Nyala (Tragelaphus buxtoni), Ethiopian Wolf (Canis simensis), Starck's Hare (Lepus starcki).

Generally speaking, the main wild life concentrations in the country occur in the southern and western parts. The wild animals in Ethiopia can be classified into five major groups:

1. Common wild animals (those animals that are found in many parts of the country (e.g. *hyenas, jackals*)

2. Game (lowland) animal, (which include many *herbivores like giraffes, wild asses, zebras etc. and carnivores like lions, leopards, and cheetahs*)
3. Tree animals or arboreals (which include *monkeys, baboons*)
4. A variety of *birds* in the Rift Valley lakes
5. Rare animals (*gelada baboon and Semien fox*) scattered in highlands; walia- ibex in the Semien Massifs, Nyala in the Arsi Bale massifs).

6.4.2. Wildlife Conservation

What are the challenges of wildlife conservation in Ethiopia?

Wildlife plays an important role in several ways. The importance of wildlife can be categorized as ecological importance, economic importance, investigatory importance, conservation of biological diversities etc. Wild animals can be used for:

- scientific and educational researches (valuable information for medical purposes and environmental studies)
- physical and mental recreation (aesthetic value)
- promotion of tourism (economic value)
- its potential for domestication
- maintaining ecological balance

To prevent the destruction of wildlife a total area of *nearly 100,000* square kilometers of national parks, sanctuaries, community conservation areas, botanical gardens, wildlife reserves etc. have been established in different part of the country. Hence in Ethiopia there are:

- 21 major national parks (see Table 6.2),
- 2 major wildlife sanctuaries,
- 3 wildlife reserves,
- 6 community conservation areas,
- 2 wildlife rescue centres,
- 22 controlled hunting areas,
- 2 botanical gardens, and 3 biosphere reserves

Figure 6.2. Spatial distribution of National Parks (four national parks are not mentioned)

Source: CSA Shapefile, 2012

Even though the number and the predominant animals may vary, many of the national parks in Ethiopia have different turnovers of animals. These include buffaloes, zebras, lions, elephants, ostriches, giraffes, oryx, African wild asses, etc.

Table 6.2: National Parks of Ethiopia

S.no	Name	Region	Year est.	Area in sq.km
1	Kafeta Shiraro	Tigray	1999	5000
2	Semien Mountains	Amhara	1959	412
3	Alatish	Amhara		
4	Bahir Dar Blue Nile River Millennium	Amhara	2008	4729
5	Borena Saynt	Amhara	2008	4325
6	Yangudi-Rassa	Afar	1969	4731
7	Awash	Oromiya and Afar	1958	756
8	Dati Wolel	Oromiya	2010	1031
9	Bale Mountains	Oromiya	1962	2200
10	Yabello	Oromiya	1978	1500
11	Abijata Shala	Oromiya	1963	887
12	Arsi Mountains	Oromiya	2012	
13	Geralle	Somali	1998	3558
14	Gambella	Gambella	1966	4650
15	Nechsar	SNNPR	1966	514
16	Omo	SNNPR	1959	3566
17	Mago	SNNPR	1974	1947
18	Maze	SNNPR	1997	202
19	Gibe Sheleko	SNNPR	2001	248
20	Loka Abaya	SNNPR	2001	500
21	Chabra Churchura	SNNPR	1997	1190

Source: Young, 2012

Some of the national parks are unique in their wild animals they have. E.g.

1. ***Abiyatta-Shalla lakes National Park*** is predominantly bird sanctuary. Important bird species include the flamingos and pelicans.
2. ***Omo, Mago*****, and *Gambela*** *National Parks* have hippopotamus and crocodiles in rivers and lakes.
3. ***Semien*** **and** ***Bale Mountains National Parks*** have rare animals like W*alia ibex, Semien fox, gelada baboon and Nyala.*

6.4.3. Challenges of wildlife conservation in Ethiopia

Do you know that if you leave nature to its own system, it has notable system of taking care of itself!

Conservation of Ethiopia's biodiversity and ecosystems is vital to ensure sustainable development, to mitigate and adapt to the effects of climate change and to prevent the collapse of life-supporting ecosystem services. Protected areas were created to protect the major biodiversity. However, it is a sad fact that these ecologically fundamental resources are usually undervalued and are under threat from various dimensions. Here are some of the major challenges that Ethiopian protected areas are facing;

- Limited awareness on the importance of wild life
- Expansion of human settlement in protected areas.
- Conflict over resource
- Overgrazing (fodder and wood)
- Illegal wildlife trade
- Excessive hunting
- Tourism and recreational pressure
- Mining and construction material extraction
- Forest fire

Check!

1. Discuss the major soil types of Ethiopia.
2. What are the three types of soil degradation?
3. What are the mechanisms of controlling soil erosion?
4. Discuss the five groups of natural vegetations in Ethiopia?
5. Discuss the vegetation and wildlife degradation?
6. What are protected areas? Identify the major protected areas in Ethiopia.

CHAPTER SEVEN
POPULATION OF ETHIOPIA AND THE HORN

7.1. Introduction

Human beings are producers and consumers of wealth from natural resources. In their interaction with nature for a living, humans both develop and destroy their environment. Human population can be considered as a point of reference from which all the other elements are observed, and from which they all, derive their significance and meaning.

Many disciplines like Geography, Demography, Economics, Epidemiology, Sociology and many more study human population. Their differences lie in the methodologies they employ and the aspects they emphasize. Since Geography is basically the study of regional/areal differences in the distribution of natural and cultural phenomena, the study of population in Geography aims at showing and explaining regional/spatial differences on population distribution and densities, population numbers, human-environment interactions, population dynamics (fertility, mortality and migration), as well as population characteristics and qualities (age, sex, education and health composition etc.).

Population numbers, dynamics, densities, characteristics and qualities vary in space. These variations can be studied at different levels: district, provincial, regional, national, continental and global. The concern, in our case, is to study the densities, characteristics and some qualities of the population of Ethiopia and some neighboring Horn countries.

Objectives

After the completion of this chapter, you will be able to:

- Discuss the importance and sources of population data
- Compute basic demographic rates
- Develop an understanding of the population characteristics and dynamics of Ethiopia and the Horn
- Describe the spatial distribution of the Ethiopian population and provide justifications for its unevenness

- Explain the process of urbanization in Ethiopia and look into the opportunities and challenges

Activities

1. How do countries get reliable population data for their socioeconomic development planning endeavours?
2. What are the challenges and opportunities of a young and growing population?
3. Why is Ethiopia the least urbanized but rapidly urbanizing country?
4. Discuss the factors that explain the unevenness in the distribution of the Ethiopian population.

7.2. Population Data: Uses and Sources

Regular and reliable population data are vital for effective socioeconomic development planning and administration. Such data are needed to plan for the provision of infrastructures such as schools, hospitals, roads, water and sewerage facilities, housing, establishing voting district boundaries, estimating future tax revenue and designing public programs. Hence, demographic data are crucial to administrators, businessmen, researchers, academicians and planners. The population of a country is an agent as well as a beneficiary of any planned socio-economic development undertaken. Therefore, it becomes inescapable to have population information as the demography influences production, distribution, consumption, defense and administrative services at any administrative or natural unit considered.

There are three conventional sources of obtaining population data namely census, sample survey and vital registration.

A. Census

A census could be defined as the total process of collecting, compiling and publishing demographic, economic and social data pertaining at a specified time (s) to all persons in a defined territory. Its major characteristics include:

- **Universality:** inclusion of all persons in a given area during the count,

- **Periodicity:** census undertaking at regular time intervals with reference to a defined point of time usually 10 years and 5 years,
- **Simultaneity:** undertaking census in a very limited time duration called the census day/night,
- **Government sponsorship** being an expensive endeavour, and publication

There are two procedures for collecting census data: dejure and defacto approaches

- **Dejure approach:** it involves counting people according to their usual place of residence (where he/she lives most of the time). This system gives a picture of the total permanent population of an area thereby making it suitable for planning and administrative purposes.
- **Defacto approach:** Under this approach each individual is recorded at the place where he/she was found at the time of the census. The defacto enumeration may give enlarged totals to holiday resorts.

B. Sample Survey

This is a method in which a defined population/sample/ is selected with the view that information acquired would represent the entire population. This method is advantageous over census as costs can be greatly reduced; and it is simple to administer and taken much faster. Sampling may also be used with censuses in order to obtain more detailed information to supplement census data. However, sample surveys have the inherent weaknesses related to sampling errors and inadequate coverage thereby demanding caution in their undertaking.

Data from most censuses and sample surveys include geographic location, age, sex, marital status, citizenship, and place of birth, relationship to the head of household, religion, educational characteristics, occupation, fertility, income, language, ethnic characteristics, disabilities and migration.

C. Vital Registration

Vital registration is a system of continuous, permanent, compulsory and legal recording of the occurrence and the characteristics of vital events like births, deaths, marriages, divorces, and adoptions. Vital registration data tend to be more precise than that of census/sample survey and the system provides time series data.

Despite the enormous usefulness of population information, it could be noted that population data could suffer from inaccuracy resulting from: poor and inadequately financed methods of collection; poorly trained enumerator; suspicion and ignorance of censuses and false statements specially of age and income; constant changes in administrations; omission of more inaccessible areas; as well as wide difference in connotation of terms like language, ethnicity, and occupation. The errors are likely to be introduced at the stage of data collection, data processing, analyses and the writing up of the report. As such, the errors need to be detected and all the necessary adjustments made to enhance their usefulness.

Check!

- Who are the users of population data?
- How many times has Ethiopia undertaken a census? What does the inter-censual population change look like at least in terms of number and its dynamics?
- Why are some individuals reporting false data pertaining to their age and income?

7.3. Population Dynamics: Fertility, Mortality and Migration

Introduction

The population of any particular region (country) grows/declines as a result of the combined effect of the three demographic variables: fertility, mortality and migration. Ethiopia is endowed with a large and fast-growing population ranking 2nd in Africa after Nigeria. According to the first ever census return of 1984, the population of Ethiopia was 42.2 million. The estimated rate of growth of the population in 1984 was 2.9 percent. The total population grew to 53.5 million in the second census held in 1994. The country's population reached about 73.8 million in 2007. Based on projected data from CSA, Ethiopia has an estimated 2019 population of 112 million,

which ranks 12th in the world, and the current growth rate is about 2.6%. The largest part of the population (80%) is rural based. Like many other developing countries, Ethiopia has a youthful population where about 65 percent of the population is below 24 years of age. The population is also unevenly distributed.

7.3.1. Demographic Measurements

In Ethiopia, fertility and mortality are the two principal determinants of population growth as international migration is insignificant. Some of the basic demographic measurements include:

1. **Crude Birth Rate** refers to the number of live births per 1000 population

$$\text{CBR} = \frac{\textbf{Total annual live birth}}{\textbf{Total midyear population}} x1000$$

2. General Fertility Rate refers to the total number of live births per women of reproductive age

$$GFR = \frac{Total\ annual\ live\ birth}{Total\ women 15-49} x1000$$

GFR is a relatively specific measure of fertility as it specifically relates births to women in the reproductive age.

3. Total Fertility Rate (**T.F.R**.) refers to the average number of children that a woman would have at the end of her reproductive period if the current age specific fertility rate remains unchanged.

$$TFR = 5x \sum_{n=1}^{7} \frac{Bi}{Wi}$$

Where, B*i* = Total live births in age group *i*,

W_i =Total number of women in age group I (i =age group i.e. 1= 15-19, 2=20-24 3=25-29, 4 = 30-34, 5 = 35-39, 6=40-44, 7 = 45-49)

4. **Crude Death Rate** refers to the number of deaths per one thousand population in a year

$$\text{CDR} = \frac{\text{Total annual Death}}{\text{Total midyear population}} \text{x1000}$$

5. **Infant Mortality** rate refers to the total number of deaths of infants per one thousand live Birth

$$IMR = \frac{Total\ annual\ infant\ death}{Total\ live\ birth} x1000$$

Infant mortality draws special attention because of its large size and the heavy impact it has on the crude death rate. The 2016 demographic and health survey result showed that infant mortality in Ethiopia has decreased from 97 deaths per 1,000 live births in 2000 to 48 in 2016.

6. **Maternal Mortality Rate**: refers to death of mothers in connection from pregnancy and birth complications per hundred thousand live birth.

$$\text{MMR} = \frac{\text{Total annual maternal death due to birth complications}}{\text{Total live birth}} x100{,}0000$$

7. **Life Expectancy at birth**: refers to the average number of years that a newly born baby is expected to live. It is used as a summary measure of the mortality experience of the whole population.
8. **Natural Rate of Increase:** is the difference between crude birth rate and crude death rate expressed in percentage.

   NRI= (C.B.R. - C.D.R.)

7.3.2. Levels and trends in Fertility and Mortality rates in Ethiopia

Birth and death rates show significant spatiotemporal variation. Clear differences in birth and death rates are emerging between rural and urban areas of Ethiopia. Urban areas have lower birth and death rates compared to rural areas implying that living and health conditions are better and, perhaps, family planning programme is gaining ground. Women in rural areas have an average of 5.2 children, compared to 2.3 children among women in urban areas.

Looking at TFR by region, in 2016 fertility was the lowest in Addis Ababa (1.8 children per woman) followed by Dire Dawa (3.1), Gambella (3.5), and Amhara (3.7); while regions that have TFR rates more than the national average are Somali (7.2), Afar (5.5), Oromia (5.4), and Tigray (4.7). Recently, fertility is showing a declining trend. Total fertility rate (TFR)

declined from 7.52 in 1984 to 6.74 in 1994, and currently, women in Ethiopia have an average of 4.6 children.

Similarly, mortality rates are also showing a declining trend. Before 2000, almost all regional states recorded more than 100 infant deaths per 1,000 live births, but by 2011 infant mortality in all regions was lower than 100, except for Benishangul Gumuz. Mortality rates also show considerable variation by reigns. In 2016, IMR at the country level was 54 where it was 48 in urban areas and 62 in rural Ethiopia. Accordingly, lower than national average infant mortality rate was recorded in Addis Ababa followed by Somali and Gambella; while higher IMR was recorded in Benishangul, followed by SNNPR and Tigray.

Life expectancy at birth in Ethiopia increased from about 36.7 years in the 1960s to 62.6 years in 2016. Female life expectancy (65.4 years) is about four years higher than male life expectancy (61.2 years). Life expectancy at birth is greater for urban areas than for rural areas. It exceeds the national average in Addis Ababa; while the lowest is in Benishangul-Gumuz (47 years) followed by SNNPR (49 years). The relatively high life expectancy and low infant mortality rates for Addis Ababa may result from relatively easy access to health services.

Comparison of birth and death rates of Ethiopia with some neighboring Horn countries as well as with world countries experiencing the highest and lowest values for the demographic rates, will help us understand where we stand.

Table 7.1: Comparison of Birth and Death Rates and Life Expectancy of Ethiopia with Selected Countries.

Country	C.B.R	C.D.R	I.M.R	Life Expectancy (Years)
Ethiopia	36.5	7	49.6	62.6
Kenya	23.9	6	37.1	64.3
Somalia	36.6	11	94	52.8
Eritrea	29.6	7	45	65.2
Djibouti	23.4	8	45.8	63.6
Highest Values	Angola/Niger= 44.2	Lesotho=15.0	Afghanistan=110	Monaco=89.4
	Mali= 43.9	Lithuania=14.6	Somalia=94	Japan=85.3
Lowest Values	Monaco=6.6	Qatar=1.5	Monaco=1.8	Chad=50.6
	Japan=7.7	UAE=1.9	Japan=2	Guinea Bissau=51.0

Source: Population Reference Bureau, population data sheet, 2017

As indicated in Table 7.1, there is an obvious difference between developed and developing countries in the demographic rates. All demographic rates are high and life expectancies are low for developing countries. Even among the five neighbouring countries as part of the developing world, Ethiopia's infant mortality rate is higher than Kenya, Eritrea and Djibouti, giving Ethiopia the lowest life expectancy among the counties. It is wise to note that Ethiopia's crude birth rate, crude death rate, and infant mortality rates are about 5.5, 4.7 and 27.5 times greater than the countries that have the lowest crude birth rate, crude death rate and infant mortality rates in the world respectively. People living in the country with the highest life expectancy at a global level live about 27 years more than ours. It is only the war-torn Somalia that has the highest death rate and the lowest life expectancy from our neighbors.

It is also important to note that the difference between developing and developed countries in crude death rates is not as high as the difference in birth rates. The main reason for this is

some degree of improvement in medical services in most developing countries during the last few decades. As opposed to declining death rates, birth rates have remained high due to:

- Little family planning practices and lack of population education;
- Lower status of women
- Early marriage, particularly of females;
- Parents consideration of children as assets, though little obliged for their education, health;
- The relatively high infant and child mortality rates, that trigger couples to have more births to compensate for the loses and
- Perhaps religious influences.

Countries of the Horn of Africa have higher population growth rate that exceeds 2.6 percent. Their population is growing faster and annual addition to the total population is enormous. Some of the consequences of this rapid population growth under conditions of slowly growing economy include:

- low per capita GNP
- increased unemployment and under -employment
- mounting social ills such as destitution, begging, theft, prostitution
- continuous inflation that erodes purchasing power of the currency
- shortage of cultivated land and food shortages
- overcrowding of infrastructural and social facilities; housing problems and increase in urban slums and squatter settlements
- Environmental problems such as deforestation, soil erosion, loss of biodiversity and pollution.

7.3.3. Migration in Ethiopia and the Horn

Migration is an old and inevitable phenomenon, although human mobility has accelerated these days as a result of economic and technological progress especially in the fields of communication and transportation. It is considered as a form of geographic mobility involving a permanent or semi-permanent change of residence between clearly defined geographic units.

An assessment of human mobility is pivotal for its diverse effects. Some of the multifaceted implications of migration are indicated hereunder:

- Migration yields an increased level of urbanization;
- It enhances rural-urban linkages in creating an integrated economy
- It influences spatial population distribution
- Migration negatively influences human fertility and mortality patterns and levels; and affects age and sex composition of the population.
- It is a means of achieving economic efficiency.
- It can also be a cause and consequence of inequality and unequal development
- It is regarded as a cause and consequence of diversity; and a mechanism of spreading cultures
- It is a necessary condition for the creation and strengthening of a sense of nationhood and national unity
- It creates a creative and open society to new ideas than a homogenous group of people.

A. Internal Migration in Ethiopia

Ethiopia is an ancient original abode of human migration before the various parts of the world are occupied. In Ethiopia, both short and long migratory movements have been going on for millennia in time and space influenced by demographic, environmental, socio-economic and political factors.

Population movement in Ethiopia accelerated in the early twenty century with the rise in urban centers as well as the Italian occupation. However, voluntary and individual rural out migration during the Derg Regime was low for the following reasons.

- The 1976/77 'land to the tiller' granted land to the rural landless farmers, which in turn reduced their motivation for out migration.
- Establishment of urban dwellers association and rural peasant associations that demanded a person to be either a member of an urban kebele or PA that did not encourage rural-urban or urban-rural migration.
- The 1975 urban land nationalization that dispossessed landlords' rights to own more than one house that further led to a chronic shortage of urban housing which in turn discouraged migration.

- The high level of urban unemployment and underemployment coupled with declining real incomes and growing poverty was a disincentive for potential migrants.
- The Derge was also taking away whoever is scrounging around in the city as soldiers to the warfront that kept the youth from moving to the urban areas.

During the current regime, the ethnic politics in the country and associated administrative barriers are said to discourage inter-regional migration and sound spatial distribution of the rural population. The incumbent government's policy that demands continued residence in one's rural kebele/PA as a condition for claiming access to land also discourages the movement of rural population out of agriculture. Another restriction to distant migration out of rural areas is the high cost of migration relative to expected employment opportunity and return.

However, landlessness of emerging rural youth; drought and rainfall unreliability in the highlands; and land degradation and the resultant diminished carrying capacity of the land could be important push factors in the out migration of people out of their rural domicile. Internal migration in Ethiopia is, therefore, among the highest in Africa. According to the 2007 Census result, the country has a relatively high level of internal migration where out of the total population of the country, 16.6 percent is labeled as migrant population.

B. International migration

International migration in Ethiopia accelerated after the 1974 revolution where many refugees were attempting to escape political conflict, persecution and famine. Attempt of political centralization and oppression; the independence struggle of Eritrea from 1961-1991 that led to violent clashes in the North; and the period of Red Terror between 1976-79 generated massive emigration from Ethiopia.

Today, Ethiopia could be considered as one of the countries that has a large number of emigrants overseas. Ethiopia's diaspora, estimated to be about four million, is also considered one of the largest of all African countries. Large numbers of Ethiopian migrants are found in the Middle East, USA, Canada, Europe and African countries such as Sudan, Kenya, South Africa and Botswana.

The causes of cross-border migration include:

- Lack of employment and livelihood opportunities, and negative attitudes attached with low paying and informal job and poor work ethics amongst the youth.
- Rural underemployment and lack of resources
- Unfavorable political context and insecurity, civil war and political turmoil,
- Ethiopia's location in the fragile region of the Horn of Africa and its long boundary that extends over 5,328 km which makes border management difficult
- Existence of large number of local brokers with networks extending to countries of destination;
- Misinformation and false promises by brokers/traffickers; success stories of pioneering migrants; family and peer pressure
- Emergence of 'culture of migration' and migration networks
- Demand-side factors of migration (shortage of labour in low-paying, informal, and perilous jobs, such as domestic work, construction, agriculture in destination countries)

Ethiopia is a country of origin, transit and destination for international migration. Ethiopia appears to be a hub on three land routes of which one leads from the Horn of Africa via Sudan, Chad, Egypt and Libya to the Mediterranean Sea towards Europe; the second through Somalia and Djibouti to Yemen across the Gulf of Aden and Red Sea towards the Middle East. 60 to 70% of Ethiopians migrating to the Middle East are irregular migrants. The third migration route is the Southern irregular route that is an overland route Kenya Tanzania towards to South Africa. Bole International Airport is also reported to be a hub of transit on the air route leading to Europe, and the Middle East.

International Labour Organization/ILO/ in 2016 identified the following migration source areas of Ethiopia with high and growing incidence of emigration:

a. Dessie (North and South Wollo) area: it includes Kemise, Bati, Kalu (Kombolcha), Dessie and its surroundings, Tehuledere (Haiq, Girana, Bistima, Bakaksa, Worebabo), Mersa, and Woldia.

b. Shashemene (Western Arsi and Bale) area: it include Shashemene-Zuria, Kofele, Kore, and Assassa.

c. Jimma (Western Ethiopia) area: includes Kaffa, Wolega and Iluababora, and more specifically Mana, Kerisa, Dedo, Agaro, Setema, Sigmo, and Gomma areas.

d. Mekelle/Tigray area: specific localities include Alamata, Kobo, Raya, Erob, Edagahamus, Gulomehadi, Etsebi, and Weneberta.

Other prominent emigration source areas include (Assela-Zuria, Adama-Zuria, Ambo, Fitche, Chancho, and Western Hararghe (Hirna, Gelemso); Shewa Robit, Debre Birhan, and Debre Tabor).

As a major destination country, Ethiopia hosts the second largest number of refugees in Africa. According to UNHCR 2019, refugee and asylum seeker population in Ethiopia was about one million. Many migrants, refugees and asylum seekers entering Ethiopia are escaping political and civil unrest as well as harsh or undesirable conditions (e.g. drought) in neighboring countries of South Sudan, Somalia, Eritrea and Sudan.

Check!

1. What is special to the areas mentioned above to be major emigration source areas?
2. What are the consequences of illegal cross-border migration on the migrants, migrant families, and the country at large?
3. What are the measures that should be taken to minimize illegal cross-border migration and promote safe migration?

7.4. Age and Sex Structure of Ethiopian Population

Age Structure refers to the distribution of population by age groups. The most used age groups are five-year age groups (0-4, 5-9, 10-14, ..., 60-64, 65 and above) and broad age groups (0-14, 15-64, 65 and above).

Table 7.2: Percentage distribution of the population of Ethiopia by broad age groups in the three consecutive censuses (1984, 1994 and 2007).

Census year	Broad Age Groups			Dependency ratio		
				Youth dependency	Old age dependency	Total dependency
	O – 14	15 – 64	65 +			
1984	49.8	50.2	3.4	107.8	16.2	124.0
1994	45.4	51.4	3.2	92.0	10.7	102.7
2007	45.0	51.9	3.2	86.7	6.1	92.8

Source: CSA, Statistical Abstract, 2007.

Age groups 0-14, 15-64 and 65 and above are known as young age, working age and old age, respectively. Our young age population is very large, about half of the population, while the old age population is very small. Because of the predominance of young age population, the median age of the population is about 17 years. The high percentage for the young age group is the result of high birth rate and natural increase, while the small percentage of the old age group is the reflection of high mortality rate, which results in low life expectancy. On the contrary most developed countries have working age population of about 60 percent or more, and old age population of about 10 percent or more.

It is generally accepted that people in the young and old ages are dependent on the working age population. Age dependency ratio (A.D.R.) can roughly be used to show the magnitude of dependency. It is expressed as:

$\text{A. D. R} = \frac{\text{P}_{0-14}+}{\text{P}_{15-64}} \ldots \text{X } 100$ Where**: P** is population in the age groups

Another ratio that can be calculated out of the broad age groups of the population is the old age index. This index expresses the old age population as the percentage of the working age population as follows:

$$OI = \frac{P_{65}+}{P_{15-64}} X100$$

Youth dependency ratio and old age index for Ethiopia's population in 2007 were about 93 and 6 respectively. This means that for every 100 persons in the working age there were

about 93 young dependents and 6 old persons of 65+. In 2015 the total dependency ratio declined to82.1; and youth dependency ratio was75.8.

If male and female population is classified into five-year age groups, a population pyramid can be constructed. From population pyramids we can tell which groups have large number of people, which age groups have male-female imbalances, and the fertility and mortality situations.

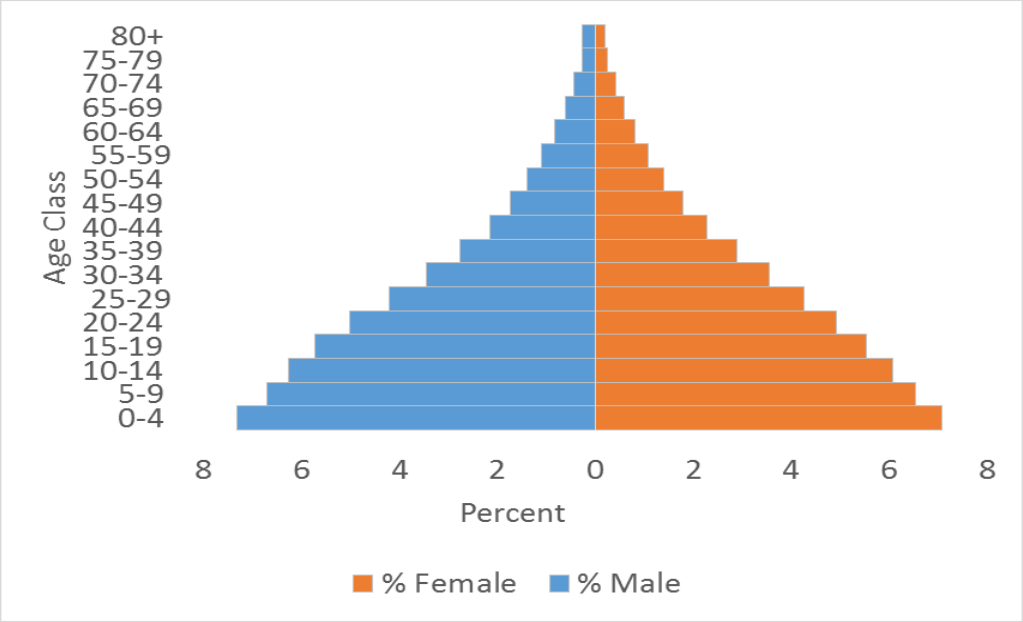


Figure 7.1: Population pyramid of Ethiopia, 2017

In general population pyramids of developing countries like Ethiopia have very broad bases showing the preponderance of young age population, and become thinner and thinner upwards as age advances. So the percentages of population in upper age groups are very small.

The age distribution of the population of Ethiopia shows that the country has a youthful population resulting in heavy youth dependency. Heavy youth dependency has many serious implications on socioeconomic development, which include:

i. Imposition of heavy burden on the working population
ii. allocation of most of the household budget to food and other household needs with little/nothing left for saving; which then affects investment
iii. diversion of limited resources on social services - building of schools and hospitals and purchase of medicines, etc. which could have been geared to directly productive investment; and
iv. creation of a society with booming babies that require an expansion of employment opportunities by the time they are of age
v. further promotion of high-level fertility by increased number of women entering the reproductive age (ages 15-49) annually.

All these mean that the capacity to save is seriously constrained at both household and national levels, thereby negatively affecting capital formation, investment and development; and this could continue for years to come.

Sex Structure

Sex structure refers to the ratio of male population to female population at different age groups. It is usually expressed as:

$$Sex\ ratio = \frac{\text{Male}}{Female} x100$$

According to the 1984 census result, sex ratio for the population of Ethiopia was 99.4. This means that there were about 99 males for every 100 females. The respective figures for rural, urban and Addis Ababa populations were 100.9, 86.8 and 90.2. The 1994 census result shows that it was 101.3 for the country and 102.6, 93.3 and 94, respectively, for rural areas, urban areas and Addis Ababa. In 2015, male to female ratio for Ethiopia was 99.96 males per 100 females. Sex ratios are generally lower for urban areas, and higher for rural areas primarily due to larger female in-migration to urban areas. Sex composition of the population also shows some variation by region. In Afar, Somali and Gambella, the number of males exceeds that of females, while in Addis Ababa the number of females is considerably higher than the number of males.

Sex ratios also vary with age. At birth and young ages males tend to be greater in number, but they become increasingly less as age increases. Hence, sex ratios are high in young age groups and low in adult and old age groups. Greater male births account for greater number of males and high sex ratio in young ages, but because mortality of male children is greater, the gap narrows down and the sex ratios decline to fall below 100 in twenties and thirties.

7.5. Population Distribution in Ethiopia

Population distribution refers to the arrangement of people over space that is provided for them to settle and make a living through exploiting resources. The distribution of population in Ethiopia is very uneven as a result of physical and human factors operating together. The most important physical factors that affect population distribution include climate, soil, vegetation, drainage and slope while the historical pattern of population movement, the type of economic activity, urbanization, industrialized and the demographic variables are important human influences.

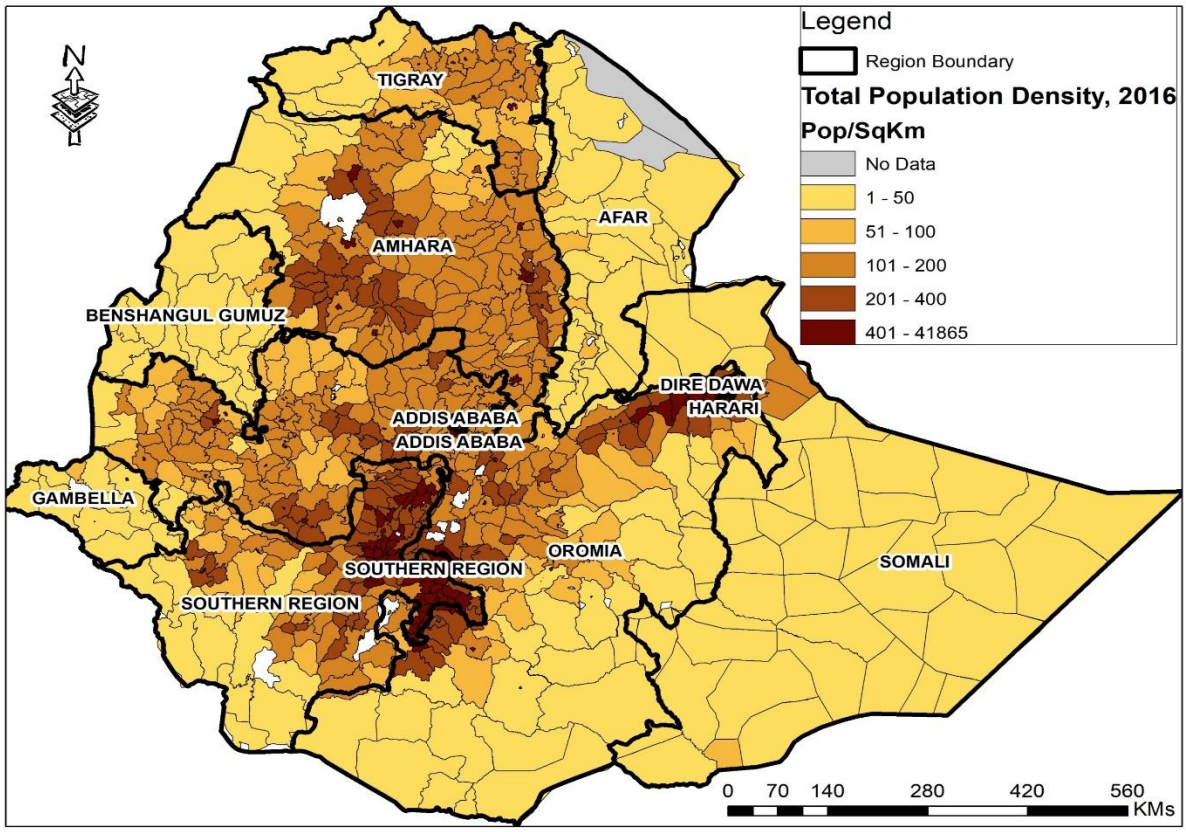


Figure 7.2: Population Distribution Map of Ethiopia

7.5.1. Measures of Population Distribution

Population Density

Population density refers to the number of people per unit area. There are several ways of expressing population density, three of which will be mentioned here.

A. ***Crude Density***

Crude density is found by dividing total population to total area. This kind of density is called crude because it does not show variations in population distribution within a given area. In 1990 crude density for Ethiopia was 40.74 people/km^2 and this has increased to 52 people /km^2 in 1998; and it amounted to more than 100 currently.

There is considerable variations in population density among the administrative regions of the country. Excluding the urban based administrative regions, Southern Nations,

Nationalities and Peoples (SNNP) region is the administrative area with the largest population density (173 people/km^2) followed by Amhara region. Gambella (13 people/km^2), Somali, Afar and Benishangul-Gumuz are regions with low densities of population. Crude population density conceals /much of the variations within regions.

Table 7.3: Population Density of Ethiopia for 2015 by Administrative Regions

Region	Population	Area(km^2)	Density(p/km^2)
Tigray	5,247,005	84,722	61.9
Afar	1,723,000	72,053	23.9
Amhara	20,401,000	154,709	131.9
Oromia	33,692,000	284,538	118.4
Somali	5,453,000	279,252	19.5
BenishangulGumuz	1,005,000	50,699	19.8
SNNPR	18,276,000	105,476	173.3
Gambella	409,000	29,783	13.7
Harari	232,000	334	716
Addis Ababa	3,273,000	527	6,210
Dire Dawa City Adm.	440,000	1,559	282
Total	90,078,000	1,063,652	84.7

Source: CSA, Statistical Abstract,2015.

The variation in crude density could be more pronounced if we consider subordinate administrative units in the hierarchy. For example, there is an enormous variation in density among the zones in Ethiopia. Some of the zones with very high densities are Gedeo, Sidama, Kambata, Guraghe, Wolayta and Hadiya; where densities exceed 300 persons per sq.km. On the other hand, peripheral zones such as Kamashi, and Metekel have population densities of less than 20 persons/km^2. Likewise, if population densities of lower administrative units are considered the variations could still be greater.For instance, Wanago, Damot Gale, Aleta Wendo, Yirga Chefe, Dara, Kacha Bira, Angacha, Sodo Zuria, Shebedino and Kedida Gamela have crude densities of exceeding 500 people/km^2; while Weredas with extremely low densities include Guba of less than 10 people/km^2) include Gog, Vaso, Dolo Bay, and

Liben. Therefore, it could be generalized that "the lower the administrative unit considered, the greater the variations in population density "

Physiological Density

Physiological density is a ratio between total population and arable part of a country. Ethiopia's physiological density (for 1998) is 61.8 people/km^2. Arable part of Ethiopia, which is used as a denominator here is 969,680 km^2. Compared to Physiological densities of countries like Japan (1,732 people/km^2), Egypt (1,575 people/km^2) and Netherlands (1,220 people/km^2), Ethiopia's physiological density is very low.

Agricultural Density

This is a kind of density, which takes only agricultural population as a numerator and cultivated land as a denominator. It is also called rural density since in most developing countries there is not a significant difference between rural and agricultural population. This density measure is more meaningful than both crude and physiological density measures as it gives a better indication of the pressure of population on land resources.

Rural population per square kilometer of cropland is the highest for Somali Afar and Gambella. The large ratio is due to the smaller proportion of land that is appropriate for agriculture relative to the large landmass and small population. It is also highly likely that through the proper utilization of the land for example by using irrigation in Somali and Afar and investment in Gambella regions, the agricultural density would decline in the years ahead. SNNP region also has a high ratio compared to the national average owing to the high population relative to their agricultural land. The smallest agricultural density lies in Benishangul (3.8), Amahra (5), Oromia (5.6) and Tigray (5.9).

The two factors that explain variations in agricultural density are the proportion of cultivated land and urban population of the regions. Other things being equal, agricultural density tends to be higher where both the percentage of cultivated land and the percentage of urban population are low.

7.5.2. Factors Affecting Population Distribution in Ethiopia

The distribution of population in Ethiopia is very uneven. This extreme unevenness is the result of the combined effect of physical and human factors which shall be discussed hereinafter.

Physical Factors

The most important physical factors that affect the distribution of population in Ethiopia include climate, mainly rainfall and temperature, soil and vegetation. The other physical factors include drainage and slope. High temperatures in combination with low and irregular rainfall diminish habitability I the lowlands of Ethiopia. On the other hand, the highland plateaus of Ethiopia where rainfall is high and temperature is moderate tend to be densely settled. The effect of climate upon population distribution is immensely important not only directly upon humans but also indirectly through its influence upon soils, vegetation and agriculture.

Steep slopes and surface ruggedness play their own part in restricting human access, habitation and cultivation. Since soil formation and vegetation growth are closely associated with relief, wherever the landscape is not significantly broken or dissected, soils tend to be good and vegetation cover richer. Likewise, attractiveness of a region for human occupation may depend partly on the nature of the soil. The fertile volcanic highland soils of Ethiopia offer a partial explanation for the high concentration of the population in the plateaus. In Ethiopia most of these physical factors are influenced by altitude.

Table 7.4: Population-Altitude Relationships

Altitude (m)	Percentage of area	Percentage of population
> 2,600	5.8	10.4
1,800-2,600	31.8	67.1
1,400- 1,800	28.1	11.5
1,000-1,400	13.4	8.2
<1,000	21.5	2.8
Total	100.0	100.0

Source: Aynalem Adugna, 1987.

Table 7.4 shows that 77.5 percent of the population of the country lives in areas above 1,800 meters above sea level which makes37.6 percent of the total area. The area above 1,400,

which makes up 65.7 percent of the total area of Ethiopia, supports 89.0 percent of the population of the country. However, caution could be made as there are many severely dissected areas within the highlands with a few or no people.

Lowlands are characterized by scarcity of rainfall, high temperature, and poor vegetation and soil conditions. In addition, the lowlands tend to be infested with tropical diseases like malaria and yellow fever that contribute to the sparse population distribution. Unlike the high population concentration along the valleys of major rivers of the world such as the Nile, Indus and Huang He; the disease infested narrow and steep valleys of major rivers of Ethiopia are areas of sparse population distribution. However, with improvements in irrigation agricultural and other development projects as well as medical technology, the lower valleys of the major rivers of Ethiopia are likely to attract more people from the highlands.

Human Factors

Human factors which have influenced population distribution in Ethiopia may be divided into two:

A. The historical pattern of population movement and
B. Types of economic activities.

The Historical Pattern of Population Movement

After the decline of the Axumite Empire, there was southward movement of the Tigre, Amhara, Agew and Guraghe populations starting from the 7th century. There was also large-scale northward movement of the Oromos during the 16th and 17th centuries. The two waves of population movements, one from the north, and the other from the south, offer a significant explanation of denser population distribution in and around the central highlands.

Economic Activities

Types of productive activities strongly influence the carrying capacity of land; and the carrying capacity in turn influences the number of people that can inhabit an area. The arid and semi-arid lowlands of Ethiopia that are inhabited by pastoralists and semi-pastoralists are sparsely settled. Hence, with pastoral herding, population densities are extremely low.

Compared to areas of pastoral herding, cultivated lands have greater carrying capacity thereby supporting higher population densities. However, the type of crop cultivated could also result in varying densities. For instance, the northern and north central areas of Ethiopia with cereals as the main crops have relatively low yield per unit area; and hence they have relatively low carrying capacity and moderate density. On the contrary the **ense**t and coffee regions of Ethiopia have greater yield per unit area that gave rise to the very high density of population in some South-central Zones and weredas.

The development of commercial farms in some parts of Ethiopia like the Awash valley is also a significant factor in causing population movements and changes in the population concentration. Likewise, urban and industrial growths as well as transportation routes can be considered as some of the important elements in bringing about population re-distribution over time and explaining density variation.

7.6. Socio-cultural Aspects of Ethiopian Population: Education, Health and Languages

7.6.1. Education

Education is the bacon of opportunity which provides a platform for a decent livelihood. Literacy is a means by which members of a society are enabled and empowered to effectively participate in the development process. High level of education correlates with higher incomes, better health, longer life span, and lower mortality. Hence, human capital development is a cause and consequence of development. Education is also a human right.

The total number of primary schools in Ethiopia was 34,867 in 2016; while gross enrollment at primary first and second cycles (grade 1-8) was 9,407,490. The Gross Enrolment Rate (GER)that shows the total number of children that have enrolled in grades 1-8, irrespective of their age, as a proportion of the school age population (7- 14 years) was 108.7%. This shows that nationally there are more children in primary grades than there are children between 7 and 14 as children younger than 7 and older than 14 are enrolling into primary schools. There is wide regional variation, with Dire Dawa and Afar having the lowest GER at 70% and 66% respectively. Gambella and Addis Ababa have very high GERs both over 140%.

As regards to the gender parity, in Addis Ababa more females are attending school than males. Lower female participation is found in Somali and Harari regions. In terms of student-section ratio, the national average is 55 for grades 1-8. Somali region has the highest ratio indicating that children in this region learn in overcrowded classrooms compared to children in other regions. The Pupil-Teacher Ratio (PTR) at the national level is 46 for grades 1-8. PTR is highest in Ethio-Somali, followed by Oromiya and SNNP; whiled Addis Ababa has the lowest.

There were 3,156 secondary schools in 2016 in Ethiopia. The national gross enrolment ratio for all secondary grades was 29.04%, (Addis Ababa has the highest GER at 82.27%.) implying that there are many children who are not completing primary education and proceeding to secondary education. Nationally GER for males is higher compared to females, though in Tigray, Amhara and Addis Ababa more females are attending secondary education. Afar and Somali regions have the lowest enrolment rate in secondary education.

However, the recent developments are encouraging and primary education is almost universalized and there is at least one primary school in each rural kebele. The number of secondary schools in both urban and rural areas in 2016 was 3156. The number of public universities has reached 45 today from only 2 in the early 1990s; where hundreds of thousands of students are enrolled in the tertiary level of education every year

7.6.2. Health

The Government of Ethiopia has been investing heavily in health system strengthening through its pro-poor policies and strategies that brought about significant gains in improving the health status of Ethiopians. Despite recognizable improvements, Ethiopia has still a heavy burden of diseases but a low rate of self-reported illness and low health facility coverage and utilization. The available literature indicates that the majority of ill health in Ethiopia is related to potentially preventable, communicable diseases and nutritional disorders.

Some of the root causes of the poor health status of the population are:

1. Lack of access to clean water: rivers and lakes remain the most important sources of water particularly for people in rural areas although such waters are largely unsafe.

2. Lack of adequate nutrition: studies reveal that malnutrition is rampant and is among the highest in the world. About half of children under the age of five are malnourished, stunted or wasted. Malnutrition still remains high as the country has not attained food security or due to poor knowledge about nutritional requirements and dietary habits.
3. Disease related to beliefs, behaviors and traditional practices which have a negative effect on health status include circumcision, early marriage, and low value of girls and children
4. Lack of health services: The health care infrastructure of the country had suffered from under funding; and health service coverage is less than 50% of the population. The services tend to be urban biased.

The combined problem of poor health and inadequate nutrition are likely to have life-long effect on children making them physically unfit, unproductive, mentally inactive and less dynamic. Since protein and energy malnutrition affects adult working population, the impact on agricultural production and productivity is likely to be high.

The major killer diseases accounting for about ¾ of all deaths include prenatal-maternal conditions, acute respiratory infection, malaria, nutritional deficiency for children under 5 years, diarrhea, AIDS and Tuberculosis.

Despite significant improvements, Ethiopia's health situation is still at a staggering situation. The current health workforce consists of 0.04 doctors, 0.43 nurses and 0.05 midwives per population of 1000, also represented as: one doctor for 26,943 people, one nurse for 2,311 people, and one midwife for 21,810 people. In order to overcome the lack of human resources for health and low utilization of health services, the country adopted a strategy to train the health extension workers (HEP) and midwives as well as scaling up family planning.

There are variations among the regions of Ethiopia in population per hospital and per hospital bed. Regions like Amara, Somali and SNNP have population-hospital ratios of over 10,000 in each case. These three regions also have high population - hospital bed ratios. The implication is that there could be many people with no chance of seeing a doctor or having an access to a hospital bed even if they wished to. Large numbers of people should also travel several tens of kilometers to arrive at the location of the nearest hospital. Since Ethiopia's high population growth rate will continue for the coming couple of years, and given the low rate at which the

services are expanding, it could be assumed that problems in education, health and other areas of services will continue.

7.6.3. Languages Families and Languages of Ethiopia

Ethiopia is a country where about 80 languages are spoken. According to the 2007 Population and Housing Census of Ethiopia, Afan Oromo and Amharic were the major mother tounges in the country accounting 33.8% sand 29.3% respectively. Somaligna (6.2%), Tigrigna (5.9%), Sidamigna (4.0%), Wolaytigna (2.2%), Guragigna (2%), Afarigna (1.7%), Hadyiyagna (1.7%), and Gamogna (1.5%) do have significant number of speakers. On the other hand, some of the languages are spoken by a few thousands.

The Ethiopian languages belong to two Supper Families: Afro-Asiatic and Nilo-Saharan. Most Ethiopian languages belong to the Afro-Asiatic Supper Family.

A. Afro-Asiatic

The Afro-Asiatic Supper Family, is divided into three families, namely: **Semitic, Cushitic** and **Omotic.**

Cushitic

The Cushitic languages are predominantly spoken in central, southern, eastern and northeastern parts of Ethiopia mainly in Afar, Oromia and Somali Regional States. It has the largest number of speakers and the widest spatial coverage. This family of languages consists of many individual languages such as Oromigna, Somaligna, Sidamigna, Afarigna, Kembatigna, Hadiyigna, Alabigna, Gedeogna, and others.

Semetic

The Semitic languages are spoken in northern, central and eastern parts of Ethiopia particularly in the regional states of Tigray, Amhara, Harari and northern Southern Nations, Nationalities and Peoples' Regional State. Some of the Semitic Languages include Amarigna, Tigrigna, Guragigna, Siltigna, Aderigna, and Argobigna.

Omotic

The Omotic languages are predominantly spoken in the south–central and south-western parts of Ethiopia mainly between the Lakes of southern Rift Valley and the Omo River. The languages, which make up this family, are numerous although they are not as widely spread as the Cushitic and Omotic. Wolaitigna, Gamogna, Kullogna, Kefigna, and Kontigna are some of the languages in this family spoken by millions and many thousands of people. Relatively small number of people speaks most of the languages in this group.

B. NiloSaharan

The Nilo-Saharan languages are spoken in the western lowlands of Ethiopia along the border with Sudan, in Gambella and Benishangul Gumuz Regional States. These Languages are spoken by small numbers of people often less than 500,000 people. The individual languages of Nilo-Saharan Supper Family include Kunamigna, Bejigna, Gumuzigna, Maogna, Kewamigna, Nuerigna, Annukigna, and others.

7.7. Settlement Types and Patterns

7.7.1. Types of Settlement

Settlements are places that are inhabited by people more or less on a permanent basis, as distinct for example from camps, and where people carry out a variety of activities such as agriculture, manufacturing and commerce. Different settlement types develop mainly in response to some physical and human factors.

Settlements are divided into two, namely, rural and urban on the bases of the dominant economic activity, population densities and availability of socioeconomic and infrastructural facilities. Towns or urban centers have non-agricultural activities as dominant, while rural areas are almost totally agricultural. Population densities are generally very high in urban area compared to densities in rural areas.

➲ **Rural Settlement**

The vast majority of the Ethiopian population still lives in rural settlements consisting of hamlets and villages. Rural settlements can be temporary or permanent depending on whether there is frequent change in the site of the settlements.

➲ **Temporary / Mobile Settlements**

The lowlands in most parts of the Rift Valley and peripheral areas, being generally hot and dry, are characterized by pastoral herding and mobile settlements. The settlements are mobile because pastoralists have always been searching for new sites for water and pasture for their livestock.

The major problem often mentioned about mobile settlements is that of providing social services like clean water, schools, hospitals, electricity etc to the people. These fixed physical infrastructures and services cannot move from place to place like the pastoralists, and to benefit from such services people have to be in permanent settlements. However, it must also be noted that settling pastoralists is not something that can be done in a year or two since it involves change of livelihood strategies, attitudes and value systems. So, it has to be considered as a serious development task that could involve the pastoralist community and governmental and non-governmental stakeholders; and perhaps it could last for generations.

➲ **Permanent Settlements**

Settlements are considered as permanent if there are no frequent changes in their locations. Most Ethiopian rural highland settlements where crop cultivation is practiced are permanent.

Permanent settlements are of two types. One of them is scattered (also called diffused or dispersed), while the other one is known as grouped/ clustered or nucleated. In areas of dispersed settlements homesteads are separated by relatively long distances which could be associated with individual land tenure and desire of people to live near to their farm holdings. Grouped settlements, on the other hand, are characterized by concentration of large number of homesteads and households at one place as for example for reasons of defense, to provide threshold population to support basic social services as was the case of villagization program during the Dergue.

7.7.2. Urban Settlements and Urbanization in Ethiopia

Urbanization refers to the increase in the percentage of the population living in urban centers. It entails the process of becoming urban, moving to cities and changing from

agriculture to other pursuits of life which are common to towns and, with a corresponding change of behavioral patterns.

Urbanization is crucial to sustain the pace of economic development and improve the quality of life for both urban and rural populations. Linkage between urban and rural areas could foster efficiency of value chains in agro-industry, improve agricultural productivity, promote service expansion and create sufficient industrial jobs in urban centers to absorb the perpetual influx of population from rural areas. However, if the rapid urbanization is not properly managed, it is presumed to bring with it a number of development challenges such as unemployment, housing shortages and informal settlements, infrastructural and service shortages, poverty and social distress.

The major criteria used to classify settlements as urban in Ethiopia are:

- ***i.*** Minimum of 2,000 people;
- ***ii.*** Two-thirds of the population engaged in non-agricultural activities;
- ***iii.*** Chartered municipality;
- ***iv.*** The presence of social services and amenities

The number of settlements meeting these criteria in 1984 was about 322. These settlements had 10.23 percent of the total population of the country and this is one of the least urban population sizes in the world. The number of settlements with greater than 2,000 people in 1994 had increased to 539. These have 12.8 percent of the country's population. In 2007, the number further rose to 927. Today, the urban population is about 20 percent of the country's population.

An overview of the History of Urbanization in Ethiopia

Before the foundation of Addis Ababa as a capital city, the earliest capitals and other towns did not have a permanent population exceeding 6000. These centers were not capable of acting as centers of influence for the life of the population of the rural hinterland in their years of existence. The only prominent urban centers were Axum, Lalibela and Gondar. For many years, in place of a fixed capital, there had been mobile military camps that followed their peripatetic rulers.

Modern urbanization in Ethiopia is associated with the establishment of Addis Ababa as a capital by Emperor Menelik II in the late 19th century. Unlike earlier capitals, there had been different factors that contributed to the growing and permanency of Addis Ababa as a capital city that are indicated as follows.

- Introduction of the fast-growing Australian eucalyptus tree which satisfied the firewood needs of the ever-growing urban population.
- Water supplies improved due to the introduction of wells and reservoirs.
- Introduction of modern schools, hospitals and health centres, hotels, cafes, bars, bakeries, butcher's shops, cinema, post office, modern cathedrals, telephone and telegraph system, bank, printing press etc.
- The construction of roads that radiate from Addis Ababa; and the arrival of the Franco-Ethiopian railway at Addis Ababa in 1917.
- The Italian occupation had also intensified the establishment of small-scale industries and institutions, road construction thereby contributing to the growth of the city.

Today, Addis Ababa is not only the capital of Ethiopia; it is also the diplomatic capital of Africa. Numerous embassies and consular representatives cluster in the mountainous city where the Organization of African Unity, now the African Union, and the UN Economic Commission for Africa have their headquarters. Addis Ababa is geographically at the very heart of Ethiopia. It has a congenial climatic condition. The city enjoys excellent connections with all Ethiopia's economic zones. It is also connected to the rest of the world via its reputed airlines and various international airlines.

For the past several decades, the country has experienced a very low level of urban development, despite its high rate of urbanization. Ethiopia is a least urbanized country even by African standards. In the words of some writers, Ethiopia is regarded as a 'vast urban desert'. The country's low level of urbanization can be attributed to:

- The self-sufficiency of agriculture which reinforced rural peasant life;
- Low level of industrialization, low level structural transformation and economic development
- The morphology of the country that hindered transportation and communication

- The continual warfare for centuries between kingdoms in to which the country is divided; and the frequent changes of the royal residence
- Lack of employment, and housing shortage in urban areas that discourage in migration;
- Political instability, ethnic conflict and social unrest during the late 1970s and 1980s;

Drivers of and Opportunities for more Urbanization in Ethiopia

These days, urbanization is proceeding at a much faster rate in Ethiopia. The urban population is growing at about 5% a year, primarily driven by migration to urban areas. The proportion of the urban population of Ethiopia in 2015 (20%) is projected to mount to 37% by 2035.Some of the conditions which have been contributing to expansion of urban areas are (drivers of urbanization):

- The establishment of Addis Ababa as a centre of expansion, and its permanency thereof.
- The construction of the Ethio-Djibouti railway line along which many stations have developed into important towns.
- The five-year Italian occupation which has contributed to road building, the establishment of small-scale industries and service giving institutions.
- The integration of the provincial capitals and major administrative centres found in all directions by all-weather roads radiating from Addis Ababa.
- Political decentralization and provision of administrative status of some urban settlements
- Proximity to existing cities and main transportation corridors trigger new urban development through agglomeration and metropolisation effects
- High Population density and growth rates in the populous highlands of Ethiopia facilitate the emergence of towns
- Presence of new and large commercial farms, mining areas, and agro-industries such as sugar factories; as well as mega projects like fertilizer factories, cement factories that attract people
- Large infrastructure investments such as airports and highways, and dry ports that attract investment and create jobs encourage urbanisation

- ❖ Opening of Universities that support entrepreneurial activity and innovation in their local economies
- ❖ Tourism assets and attractions such as parks, resort centres, and heritage cities and sites contribute to urban expansion.
- ❖ Development of border towns with strengthened inter-country trade

Distribution of Urban Centers in Ethiopia

The distribution of urban centers in Ethiopia shows considerable spatial variation. This could be explained in terms of the varying concentration of industries; and services such as schools, health institutions, water supplies, electricity, means of transport, etc. Based on varying concentrations of urban centers and urban populations, the Ministry of Urban Development and Construction identified the following hierarchy of urban centers:

i. ***The Addis Ababa Metropolitan cluster*** includes Addis Ababa and its surrounding towns; and Adama and its surrounding towns

ii. ***Secondary city clusters*** consist of:

- ➢ Lake Tana Urban Cluster: Bahir Dar, Gondar Debre Tabour, Debre Markos
- ➢ South Rift Valley Urban Cluster: Hawassa-Shashemene-Dila; and Hosana-Sodo-Arba Minch
- ➢ Eastern Urban Cluster: Dire Dawa, Harar, Jigjiga
- ➢ Mekelle Urban Cluster: Mekelle, Adigrat, Shire, Axum
- ➢ Dessie- Kombolcha Urban Cluster.
- ➢ Jima Urban Cluster: Jima, Agaro, Mizan, Tepi, Gambella

iii. ***Tertiary urban clusters*** include:

- ➢ Nekemte Urban Cluster: Nekemte, Dembidolo, Gimbi, Metu, Assosa
- ➢ Gode - Kebri Dar oasis city network
- ➢ Semera-Mille – Asaita oasis city network

Like most developing countries, Ethiopia's urban population is concentrated in one primate city, Addis Ababa. The population of Addis Ababa grew from 1.4 million in 1984 to 2.2 million in 1995, and to 2.7 million in 2007 representing about 29% of the urban population of the country. Its current estimated population is over four million.

Growth Rate of Urban Centers

The annual average national growth rate of urban population is about 5.0 percent. But this being an average, rate of growth of urban population varies from town to town and from time to time. Ethiopia's towns are characterized by wide range of growth rates that could be classified into one of the following three broad categories:

i. **Declining Towns**: it includes towns whose populations are actually declining in absolute numbers because net out migration is greater than natural increase. This could be due to lack of employment opportunities and worsening living conditions. Some of the towns that have at least once experienced a decline include, Axum, Goba and Maichew.

ii. **Slow Growing Towns**: This category is composed of towns that grow at the rate which is less than the rate of natural increase. Towns such as Holeta, Harar and Gore have been indicated to grow slowly in the recent past.

iii. **Fast Growing Towns**: All towns with growth rates of greater than the natural rate of increase make up this group. These towns pull large numbers of people from the declining or slowly growing towns and rural areas due to the opportunities they offer associated with expansion in industries, social services or a change in their administrative status as zonal or regional capitals. Given the dynamism, however, it is wise to note that a once declining town could be slowly or even fast growing after sometime and vice versa.

Review Questions

1. What conditions make provision of infrastructure and services for temporary settlements difficult? Do you know any strategies that the government is taking to address the problem?
2. What were the problems of the villagization program attempted by the Dergue?
3. Justify why Ethiopia still remains to be the least urbanized country in the world.
4. Discuss on the major problems of urban centres of Ethiopia

CHAPTER EIGHT
ECONOMIC ACTIVITIES IN ETHIOPIA

8.1. Introduction

Humans have been involved in a number of activities in order to satisfy their diverse material and spiritual needs. These activities, which are designed to satisfy the needs of human beings, are known as economic activities.

Economic activities are highly diversified in their nature and characters. Some are simple while others are complex. Some are primitive where as others are advanced. But whatsoever characters they have, all of them are equally important through satisfying peoples' needs.

Geographers classify a nation's economy into primary, secondary, tertiary or the service sectors. Increasingly the service sectors are seen as forming a fourth or quaternary sector and a fifth or quinary sector. This categorization is seen as a continuum of distance from the natural environment. The continuum starts with the primary sector of an economy that extracts or harvests products from the earth. The primary sector includes the production of raw material and basic foods. Activities associated with the primary sector include agriculture (both subsistence and commercial), mining, forestry, farming, grazing, hunting and gathering, fishing and quarrying. The secondary sector of the economy manufactures finished goods. All of manufacturing activities, and construction lie within the secondary sector. The tertiary sector of the economy is the service industry that provides services to the general population and businesses. Activities associated with this sector include retail and wholesale sales, transportation and distribution, entertainment, restaurants, clerical services, media, tourism, insurance, banking, healthcare, and law.

In this section, you will learn about the major types of economic activities in Ethiopia; differentiate their spatiotemporal distributions and their contributions to the overall development of the country.

Objectives

At the end of this chapter you will be able to:

- explain the roles of mining sector in the Ethiopian economy and the major constraints of the sector;

- discuss the contributions and challenges of fishing and forestry sectors;
- Expound the main contributions, potentials, characteristics and problems of Ethiopian agriculture;
- Explain the main contributions, potentials, characteristics, distribution and problems of Ethiopian manufacturing industries;
- Examine types, roles and distribution of transportation infrastructure and services in Ethiopia
- Identify tourist potentials of the country and look into the performance of the sector to the socio-economic development of Ethiopia

8.2. Mining Activity in Ethiopia

Brainstorming Questions

1. Are there metallic minerals and non-metallic minerals including fossil fuels in Ethiopia that could expedite its development?
2. Describe the contribution of mining industry to the economy of Ethiopia.
3. What do you think are the major challenges of the mining sector in Ethiopia?

8.2.1. Introduction

Mining involves the search for minerals from the crust of the earth. Minerals are naturally occurring organic and inorganic substances. They form important part of natural resources. Mining is important to the economy of Ethiopia. Currently, mining contributes to only 1.5 % of GDP (USD 32 billion).

As you have seen in chapter two, the Geology of Ethiopia and the Horn, mineral occurrences are associated with the geologic process. The oldest (Precambrian) rocks and the sedimentary (Mesozoic) rocks host most of the economic metallic and nonmetallic mineral deposits in Ethiopia.

So far, the developed large scale gold mine in Ethiopia is the Lege-dembi gold mine, located in the southern greenstone belt region. It is operated by private company with estimated reserve of 82 tons and an average annual production of 3.6 tons of gold.

There is also small-scale open pit mine of columbo-tantalite at Kenticha in the Adola belt. The deposit is both a weathered crust ore (the top 60 meters) with proven reserve of 2400 tons of tantalum pentaoxide and 2300 tons of niobium pentaoxide, and primary ore with proved reserve of 2393 ton Ta_2O_5 and 2362.5-ton Nb_2O_5. The Mine has been operating since 1990 with a pilot plant producing about 20 tons per year. At present it is producing over 190 tons of tantalite concentrate of tantalite colombite ore per annum. Tantalum is used in making all electronic devices such as mobile phones, cameras, computers and so forth and is thus highly demanded. Ethiopia presently supplies close to ten percent of the World production of tantalum and has a good potential for a considerable expansion of the percentage.

Secondary enriched (placer) gold has been mined traditionally (artisinaly) for years back to biblical times. Formalization of the artisanal miners has been strengthened since the early 2000's that about 1000 Kg of gold is purchased from the local miners and dealers by the National Bank of Ethiopia that in turn increases the generation of foreign currency.

Soda ash is being mined at Lake Abiyata in the Rift Valley about 200 kilometers south of Addis Ababa. The reserve at Lake Abiyata and the surrounding lakes exceeds 460 million tons of sodium carbonate at salt concentration ranging from 1.1 to 1.9%. The plant is producing about 5,000 tons soda ash per year at semi -industrial scale. The consumers of the soda ash are local caustic soda factory, soap and detergent manufacturers.

Kaolin, quartz and feldspar are also being mined from the Adola belt in southern Ethiopia by government enterprise. The consumers of the products are the Awash-Melkasa Aluminium Sulphate and Sulfuric Acid Factory and the Tabor Ceramics Factory.

Silica sand is also being mined and utilized by local industries. The cement factories of the country are using high quality limestone, clay, gypsum and pumice as a raw material for cement production.

There is also large input of construction minerals such as sand, gravel, scoria, crushed stones, aggregates, pumice, scoria, etc to the construction industry (including buildings, roads, dams, bridges etc.).

The gas fields are located in the south-eastern part of the country at Calub, Hilala and Genale gas fields in the Ogaden Basin. The gas resources potential of these fields has been assessed as 4.6 Trillion Cubic Feet (TCF).

Other mineral products including platinum from laterite, gemstones (opal and other precious stones) and decorative and construction materials are also produced by licensed foreign and local mining companies in the southern, western, central and northern regions of the country.

8.2.2. Status of the mineral sector investment in Ethiopia

The Mining laws of Ethiopia have been issued in 1993 and amended recently, to attract private sector investment compared to other developing countries mining codes. The 1994 mining regulation was also issued to make all licensing and administration procedures as transparent as possible.

Encouraging foreign and local mineral development investments have been shown since late 1990's. The total investment amount registered by the private sector to date is about 1.1 Billion US Dollars where by 95 % percent of it is direct foreign investment for the development of precious and industrial minerals.

The mining stakes in Ethiopia are held by: The Ethiopian Mineral Development Share Company, a Government organization (EMDSC) established in 2000 is engaged in all mining activities in the country; the Ezana Mining Development, functioning since 1993, a privately owned Ethiopian enterprise in consulting in all aspects related to mining including all types of explorations; the Midrock Gold, a subsidiary of Midrock Gold Group, in operation at Shakisso town in southern Ethiopia, involved in gold mining (production of 3500 kg of gold per year extracting 50,000 tons of rock per month); and the National Mining Corporation (set up in 1993), a private company involved in all facets of mineral and petroleum product production including by products.

Potash mining has generated lot of interest in recent years. Allana Potash, a Canadian mining company is poised to start mining for potash in the Afar Regional State while the Indian Sainik Potash has been working in the Dallol depression.

Prospecting for iron, gold and base metals is also in progress in many regions of the country. More and more gold mines are being located, such as in the Afar region and in the Konso Zone in south western Ethiopia.

Presently a number of junior exploration and world class mining companies are operating in Ethiopia for different mineral commodities. Apart from these there are wide ranges of future investment opportunities found in Ethiopia that hope to be of mutual benefit to the investors and the speedy socioeconomic development of the country.

8.2.3. The importance of Mining sector in Ethiopia

Economic benefits

- ***Generates revenue from sales, taxes, royalty:*** The federal government has been collecting royalty of about 48.5 million birr (4.4 million USD) from the large-scale production of gold every year for the last three years. The regional administrations also collect royalty from the small scale and artisanal production of precious minerals, industrial and construction materials.
- ***Generates foreign currency earnings:*** The amount of foreign currency earning is about 135 million dollars every year for the last couple of years from the sales of export of minerals such as gold, tantalite concentrate platinum, decorative dimension stones and gemstones. This export earning contributes up to 7-10 % of the total export foreign currency earnings of the country.
- ***Employment opportunity*****:** The contribution of mining to employment in Ethiopia is today small (a few thousand), as the sector is small and mining is not a labour-intensive industry. Artisanal mining on the other hand is likely to involve several hundred thousand workers.

Even though the country is believed to have wide mineral potential, *the contribution of the mining sector to the national economy* has been a maximum of 6%.

Social Benefits

- Expansion of infrastructures such as roads, electric power, telecommunication etc
- Expansion of social services such as health facilities, schools service, schools, water facilities as well as airstrips for the local communities.

- Train local communities to engage in other form of business such as plantation of coffee and other trees, introducing agricultural activities (irrigation)
- Promote small entrepreneur's engagement in the local community by providing services such as hotel, mini- markets, stationeries, etc.

8.2.4. Environmental issues and management related to mining

It is inevitable that extraction of minerals from the earth leads to disturb the environment. When disturbing the environment there must be careful and systemic protection of the whole system of environment that assures sustainable use of the current resource and or ecosystem and that bring about either less or almost none destruction or pollution of the environment.

The mining legislation of Ethiopia, which came in to effect in 1993 has provision that requires as compulsory criteria to study, submit and get approval of Environmental Impact Assessment from the respective Authority in order to develop large scale mining project. The common environmental issues in Ethiopia to be considered in development of the medium to large scale mining projects are the surface and ground water system, the physical land management (soil, rock stability, deforestation grass land, farm land, etc), spillage of strange chemicals/metals, air, noise, dust, aesthetic values of the area, cultural and tourist heritages, the communities as well as all other lives surround the mine proximity.

In principle the licensees shall ensure the financial mobilization of the environmental management and mine closure plan. Therefore, sinking fund is required to be pledged while the mining activity is going on and management plan shall be implemented throughout the life of the mine.

8.3. Forestry

It is related to exploiting forest products, which include gathering of fuel wood, production of timber and charcoal, and construction of houses. Forest resources of Ethiopia were described in Chapter Six, section 6.2; and in this section emphasis is given on the economic significance of forestry activity for the national economy.

Economic significance of forest

Even though the importance of forest and forest product is little in earning foreign exchange, their significance at local level is large. For instance, their contribution to the national economy in the form of GDP is about 2.5%.

Most of the trees cut in Ethiopia today are used for domestic purposes like for;

- Fuel wood,
- Timber household furniture,
- For building and construction.

This indicates that forest products are sold on the local markets at lower prices. The commercial exploitation of forest resources in Ethiopia is still in its infancy stage. This is mainly because of the following major factors;

- Rapid deforestation
- Low demand for timer
- Lack of modern lumbering technology
- Inaccessibility of natural forest

8.4. Fishery

8.4.1. Introduction

Fishing is a primary economic activity that involves harvesting of fish resources from water bodies. Fish can provide an important source of proteins in the diet for much of the world's population. Fishing is known to be one of the oldest human activities. Still fishing is the most widely spread economic activity both in private and modern societies.

Due to the presence of a number of lakes, river and reservoirs rich in fish resources, Ethiopia has great potential for fishing. However, at present there is no reliable estimate due to lack of exhaustive and systematic (regular) stock assessment. The total estimated potential yield calculated from the surface area for major lakes is 60,000 tons per year. However, in the face of the above uncertainty the potential yield stood between 30,000 and 45,000 tons per year for the main water bodies.

At present in Ethiopia, more than hundred local fish species have been identified. The bulk of the production is made of Tilapia, Bargus, Clarias and Labeo species. In the two southern Rift Valley lakes, Chamo and Abaya, Nile Perch is caught in significant quantity. Nile perch is also found in major riverine fisheries. Moreover, principal physical characteristics and the recent estimate of potential yield of the main water bodies are presented in the table given below.

Table 8.1: Estimated fish Resource potential of Ethiopian lakes

Lakes	Area	Maximum Depth	Annual Potential (1000 kg live weight)	Main Fish Species
Tana	3600 km^2	4	15,000	Barbus, Clarius, Tilapia
Abaya	1160 km^2	13	7,000	Nile perch, Bagrus, Barbus Clarious, Labeo
Ziway	434 km^2	4	3,000	Tilapia, Barbus
Chamo	557 km^2	10	3,000	Nile perch, Bagrus, Barbus, Clarious, Cyprinus
Koka	250 km^2	5	2,000	Tilapia, barbus Clarious, Cyprinus
Langano	230 km^2	45	3,000	Tilapia, barbus Clarious
Awassa	129 km^2	10	1,000	Tilapia, Barbus Clarious
Metahara Beseka	-	85	2,500	

Source: FAO,2015

8.4.2. Fishing Grounds in Ethiopia

Most fishing activities in Ethiopia take place in fresh waters, such as rivers, lakes and ponds. According to Ethiopian Wildlife Conservation Department, Ethiopia's fresh water bodies are known to have 101 species of fish, among which four are endemic to the country. In general, the Ethiopian fishing grounds could be classified as ***Lakes*** and ***Rivers***

Lakes fishery: the Ethiopian lakes are estimated to cover a surface area of about 7000 km^2. They account about 79 percent of the total yearly fish production of the country. The most important lakes where much of the fish production comes include Lakes Tana, Ziway, Langano, Hawassa, Abaya and Chamo. The annual maximum sustainable fish yields of our lake are estimated to be above 35,000 tons. However, presently only 4,000 tons are produced annually. Among the 101

species of fish available in the country 25 of them are commercial fish species and are found in the lakes. Generally, the lakes have high promising potential for the development of commercial fish industry.

River Fishery: Most rivers of Ethiopia have high fish resources. Most fish production of the river is confined to local consumption by villagers living near and around river banks. The fishing potential of Ethiopian rivers has not yet been fully known. But according to some references, the country's rivers and streams can produce; on average about 7,000-10,000 tons of fish annually. For example, river Baro alone can supply a maximum sustainable yield of 2,500 tons per year.

Table 8.2. Ethiopian water bodies and their fisheries

Water bodies type	Extent	Fishery potential (tone/year)	Catch (tone/year)
Major lakes	6,477km^2	23,342	10,598
Major reservoir and dams	857km^2	4,399	1,366
Small water bodies	275km^2	1,952	303
Rivers	7,185km^2	21,788	3,121
Total	14,794 km^2	51,481	15,389

Source: Assefa, 2014

According to FishStat data, Tilapine species averaged about 50 percent, Catfish about 22 percent and Nile Perch about 9 percent of total production over the last decade. There are seasonal variations in the availability of different types of fish, but as there are some differences between the lakes, traders can smooth out supply to some extent.

8.4.3. Demand and consumption of fish

Fish as a source of human food has a long history in Ethiopia. People consume large amount of fish in fasting days, in big cities, around production areas and towns, especially in Hawassa, Zeway, Arbaminch, Bahir Dar and Addis Ababa.

Outside these areas, however, the domestic market for fish is small. The factors which account for this low level of local fish consumption are the following.

- First, fish has not been integrated into the diet of most of the population.
- Second, because of religious influences on consumption patterns, the demand for fish is only seasonal. The demand for fish is higher than supply during fasting seasons.
- The other factors that contribute to the low level of consumption are the limited supply of the product and its high price.
- Long distance of the fish production sites from densely populated areas and major settlements, together with its perishability reduce fish consumption levels

The demand for fish is showing an increasing trend. For instance, total demand for fish in 2003 was about 67 thousand tonnes, which is predicted to grow 118 thousand tonnes in 2025. **T**he rapid growth of population and the progressive shortage of livestock products had changed the situation to a growing demand of fish.

Socio-economic contribution of the fishery sector

- ***Role of fisheries in the national economy*:** Despite the sector low contribution to the Gross Domestic Product (0.1 percent), the fishery sector in Ethiopia plays an appreciated role in terms of providing employment and income at the local level and contributing to food supply at the national level.

- ***Trade:*** The Ethiopian cross-border fish trade is currently not properly documented. However, available evidence from FAO Fishery and Aquaculture Statistics,2015 has documented that the country earned 0.4 million USD from exports and imports significant amounts of fish from neighbouring countries amounted 3.8 million USD over the recent period. The *per capita* fish food supply is around 300g, significantly below the mean 2.6 kg per capita per year for the East African sub-region.

- ***Food security*:** Fisheries are regarded as an important sector in the effort to increase animal protein consumption and achieve food security for the growing population.

- ***Employment*:** A considerable workforce is employed, both directly and indirectly, by Ethiopia's capture fisheries which also help in sustaining local communities. Whereas 4052 persons were employed directly by the sector in 2010, a total of 9,148 others benefited from indirect employment offered by the sector.

- ***Fish meal as animal feed source*:** Fishmeal is an excellent source of protein for animals. The offal of fish can be processed and used for animal feed. It has high levels of essential amino acids such as methionine and lysine, and it also has a good balance of unsaturated fatty acids. These days, there is an increased demand of fishmeal from poultry farmers.

- ***Sport fishing as a recreational value*:** Recreational fishing (sport fishing) is particularly becoming common in southern part of Lake Tana. This activity has been started in the country since 1970s.

8.4.4. Constraints and opportunities of the fishing sector

Like for most of Africa, Ethiopia is riddled with poverty, economic stagnation and environmentally unsustainable practices, all of which pose serious constraints to fisheries development. However, ample opportunities exist for the sector to help reverse national development challenges by making a significant contribution to poverty alleviation, economic growth, better nutrition and ecological improvement.

Factories, agriculture and sewage are the sources of major pollutants affecting Ethiopian water bodies and their fisheries. The extraction of minerals from Lake Abijata could have negative effect on fish stocks, just as the effluents from the tannery at Koka Reservoir and the textile industries at Hawassa and Arba Minch can affect the fisheries. Also, the increasing rate of deforestation could result in increased drying up of water bodies and increase in water turbidity. Further, the dam on River Omo has negatively affected the anadromous fish which migrate from Lake Turkana to spawn in the river.

Inadequate legal and policy frameworks have largely given rise to poor fishery resource exploitation resulting, in some cases, in the overfishing of some important species, such as the Nile perch in Lake Chamo, and tilapia in Lakes Hawassa and Ziway. Though there are fishery laws and regulations currently in place, these legislations are inadequately implemented.

The sector also suffers from limited human resource availability, with an acute shortage of trained personnel. This poses serious constraints on fishery management and technical and extension support services.

Public and private investment in fishery and aquaculture is low and the infrastructure inadequate. There is also an urgent need to invest in modern value chain-based fish processing and marketing infrastructure.

Local fish demand can be greatly increased with a change in the people's food habit, in favour of fish. Improvement in fishing techniques, technology transfer to fishers, training of fishery management personnel, attraction of financial capital to the industry, fish value chain improvement, and aquaculture, can all result to increased fish production, increased trade and overall economic development of the country.

Attractive fish prices at local market for better profit; the presence of diversified fish species; and inhabitants' traditional knowledge for fisheries and good consumption habit are considered as occasion for the sector escalation.

In addition, the future fishing villages' offers homogeneous and less dispersed pastoral communities which are ideal for social mobilization for poverty alleviation programs. Reservoir fisheries require minimal initial investment and provides quick returns compared to other economic activities. Access to microfinance facilities, which have received strong internal and external support, will therefore promote rapid development of fisheries, especially for the benefit of women and youth. It does not also require sophisticated skills and knowledge for the entry and coping up with operation at small scale level. Absence of social and culture taboo in fish consumption is also another asset for fish production in Ethiopia.

Review Questions

1. State the most important socio-economic importance of fishery sector.
2. Mention the factors which account for the low level of local fish consumption in Ethiopia.

8.5. Agriculture in Ethiopia

8.5.1. Introduction

Agriculture is defined as the purposeful tending of animals and plants. It is one of man's oldest activities, and dates back to the Neolithic period (*10,000* years before present). Even today, agriculture remains an important economic activity accounting for more than *15 percent* of the earth's cultivable land. Similarly, about *60 percent* of the world's population gets its livelihood from agriculture.

The type of agriculture practiced in any area is influenced by physical and socio-economic factors. The environmental factors like soil; climate, relief, etc. impose certain limitations on the types of crops that may be cultivated and the type of livestock that may be reared. However, in addition to such environmental factors, various socio-economic factors like farm size, type of land tenure, capital availability, transport and marketing facilities, price, government polices, etc. also influence farming patterns.

Agriculture is important for a number of reasons. It provides: basic food supplies for the population; raw materials like cotton, sugar cane, oil seeds, etc. to industries; export crops, from whose sales industries infrastructure and the like may be established; and employment for the population.

The great majority of the Ethiopian population resides in rural areas engaged in some form of agricultural activity. Agriculture is the backbone of the Ethiopian economy and therefore this particular sector determines the growth of all the other sectors and, consequently, the whole national economy. Despite a long history of agricultural practices in Ethiopian, the sector is still very backward. Farming methods and techniques have hardly changed in the last 2000 years. The sector is dominated by small-scale farmers that practice rain-fed mixed farming by employing traditional technology, adopting a low input and low output production system. It is also in this sector that the over whelming majority of the poor reside.

Therefore, in this section emphasis is given to explain to the agriculture systems of Ethiopia including its role, structure and performance, farming type and the major challenges of the sector.

8.5.2. Contributions, potentials and characteristics of agriculture in Ethiopia

The contributions of agriculture in Ethiopia

The Ethiopian economy is an agrarian economy. Agriculture is the backbone of the economy of the country as the following facts indicate.

- Agriculture accounts for most of (30- *42%)t* of the *Gross Domestic Product* (*GDP)* of the country.
- Agricultural products account for more than *90 percent* of the foreign exchange earnings of the country.
- Agriculture provides raw materials for the processing industries
- More than *80 percent* of the Ethiopian population derives its livelihood directly from agriculture.

The Agricultural Resource Base/potentials of Ethiopia

Ethiopia has abundant agricultural resource base due to its varied agro-ecological zones. The varied climatic conditions and contrasts in elevation allow for the cultivation of various crops ranging from cool weather crops to sub-tropical and warm weather crops. The country has no less than *21soil types* with varying physical and chemical features, and in the alluvial beds of major rivers close to *16 percent* of the country's area is suitable for irrigated agriculture. The country has also vast grazing land and livestock population as the country possesses a huge but largely unutilized potentials of livestock resources with a vast (55 – 58 % of its total land area) grazing land. The country has extensive livestock population, with estimated 30 – 35 million livestock units (TLU) standing first in Africa and 10^{th} in the world and numerous livestock species.

Land Use

Ethiopia has a total land area of about 113,000,000 hectares. There is no comprehensive survey of land use pattern in the country but some estimates suggest that about 12.6million hectares, 10.3% of the total area, is intensively cultivated, and a further 15.3million hectares (12.5%) is

moderately cultivated. High forest and wood land areas account for 6.9%, while grassland for 30.5% of the total area.

Accepting the estimate that some 27.9 million-hectare of land is already cultivated (intensively and moderately),the possibilities for expanding land under rain-fed agriculture is not very high. More importantly, new land that can be brought under cultivation may be offset or even outstripped by land which needs to be withdrawn from cultivation because it is severely eroded or degraded.

It is often suggested that the size of additional land that can be brought under rain-fed cultivation is limited to the 100km wide strip of land stretching from Gambella, bordering Sudan to Humera in the north. But this claim must be taken cautiously since the tropical rain forests in the western parts of the country are highly fragile and incapable of supporting permanent cultivation. It also requires heavy investment in infrastructure and machinery to cultivate the land while animal husbandry is affected by trypansomasis.

Expansion into much of the non-arable lowland areas is constrained by moisture stress. But these areas are drained by major river basins and are suitable for irrigation. It is estimated that the major river basins of the country can irrigate about 3.5 million-hectare of land. At present only about 161,010 ha or 4.6% is irrigated around the major river basins. Besides opening up new land for cultivation, irrigation allows to cultivate two or three crops each year instead of a single crop most common under dry farming. It also enables farmers to grow high value crops, especially fruits and vegetables. Nonetheless, the amount of investment required to expand irrigated agriculture around the major basins is often considerable.

Agricultural Land Use in Ethiopia

Land resource is more crucial to the livelihood of the people depending on agriculture:

- Agriculture is a land-based activity unlike secondary and tertiary activities where contribution of land to its output is greater. Thus, lack of access to land is directly correlated with incidence of poverty in rural areas.
- Quality of land has a direct bearing on the productivity of agriculture
- Land ownership has a social value and serves as a security for credit, natural hazards or life contingencies, and also adds to the social status.

Agricultural land refers to the share of land area that is arable, under permanent crops, and under permanent pastures. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.

According to the result from 2016 Agricultural Sample Survey conducted by Ethiopian Central Statistics Agency (CSA) more than 19 million hectares of land was used in different types of land use by smallholder farmers during the major season of the survey year.

The percent distribution of the land use by different types of land uses is shown in Fig 8.1. Accordingly, about 77 percent of the land operated by smallholder farmers was allocated to crops, both temporary and permanent crops while 11.5% of the land used for grazing land.

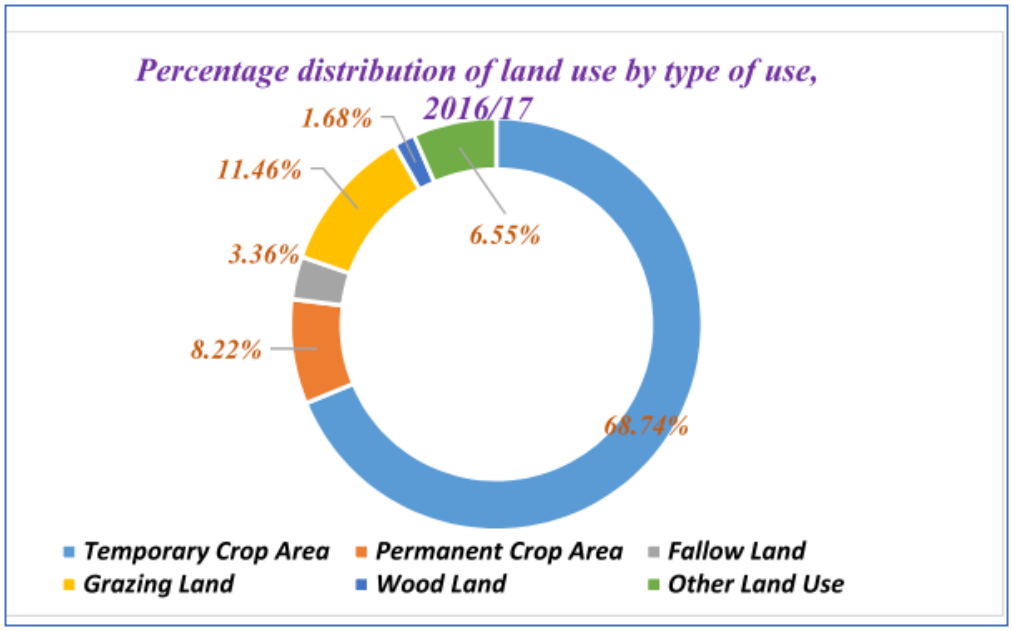


Figure 8.1.: Percentage distribution land utilization, main season 2016/17

Cropping seasons in Ethiopia

The two main crop seasons in Ethiopia are the *belg* and *meher* seasons which receive rainfall from February to June and from June to October, respectively. *belg* crop season is officially defined as any crop harvested between March and August, while the *meher* crop season is defined as any crop harvested between September and February. The *meher* crop season is the main season and produces 90-95 percent of the nation's total cereals output, and the *belg* harvest provides the remaining 5-10 percent of cereal output.

Cropping Pattern in Ethiopia

The highlands of Ethiopia are easily distinguishable from their lowland counter parts as far as the pattern of agricultural land use is concerned. The highlands do not only produce a variety of crops due to their improved environmental conditions as well as due to the variety of agro-ecological zones caused by altitudinal variations, but they also practice an elaborate system of land preparation and crop rotation.

The number of crops grown decreases as one moves from the central highlands to the peripheral lowlands. The highlands are, thus, more diversified than the lowlands. Cereals (*teff, wheat, barley, maize, sorghum, etc*,) are the most important crops in Ethiopia as indicated in the Table 8.4.

Table 8.3: Estimates of Agricultural Production and Cultivated Areas of Major Grain Crops for Private Peasant Holdings-Meher Season

Agricultural Production	2014/15		2015/16		2016/17		2017/18	
	Cultivated Area*	Total Production	Cultivated Area*	Total Production	Cultivated Area*	Total Production	Cultivated Area*	Total Production
Cereals	10,144	236,077	9,974	231,288	10,219	253,847	10,232	267,789
(Annual % Change)	3	9.4	-1.7	-2	2.5	9.8	0.1	5.5
Pulses	1,558	26,718	1,653	27,693	1,550	28,146	1,598	29,785
(Annual %	-10.6	-6.5	6.1	3.6	-6.2	1.6	3.1	5.8

Change)								
Oilseeds	856	7,601	859.1	7,848.10	805	8,392	846	8,550
(Annual % Change)	4.9	6.9	0.4	3.3	-6.3	6.9	5.1	1.9
Total	12,558	270,396	12,486	266,829	12,574	290,386	12,676	306,124
(Annual %Change)	1.2	7.5	-0.6	-1.3	0.7	8.8	0.8	5.4

Source: National Bank of Ethiopia, 2017/18

*Area in thousands of Hectares and Production in thousands of quintals

Animal Husbandry

Ethiopia has a large livestock population (1st in Africa). The distribution of livestock production in terms of agro-ecological zones and administrative regions is very uneven. About 75% of the cattle and sheep population are found in the highland zone while 70 percent of the goat and 100% of the camel population are found in the lowlands. More than 90% of the livestock population is found in Oromia, Amhara and SNNPR. The average number of cattle per household (per capital holdings) for the less densely populated Afar region and Somali where livestock are central to the livelihood of the pastoral population is the highest. Most of the total value of livestock output (70%) is contributed by cattle.

Livestock contribute 30-35% to agricultural GDP and 13-16% to overall GDP. These figures are considered as an underestimate since they do not consider the value of manure (fertilizer, fuel) and transport. The livestock sector contributes about 13% of the total value of agricultural export. The contribution of hides and skins from the livestock exports is the highest (more than 95%).

Despite a large livestock population, the contribution of the livestock sector to the national economy is limited due to primitive methods of livestock breading, cultural attitudes, higher mortality rates of livestock due to disease and other causes.

Characteristics of Ethiopian Agriculture

Even though there are some variations in the nature of practices and production endeavors of farmers based on agro-ecological diversities and socio-cultural characteristics from place to

place, nevertheless agriculture in Ethiopia also possess some basic and general characteristics. These basic attributes are:

1. Subsistence Orientation

In Ethiopia peasants produce mainly for their own household consumption and only a limited proportion is meant for the market. It is found that peasants retain up to 80% of their produce for home consumption and seeds. Similarly, Ethiopian peasants usually cultivate different types of corps (10-15) and rear different types of livestock to meet their various needs.

2. Fragmentation of farm plots and Small size of Holdings

Because of the ever-increasing population that gave rise to continuous generational division of land through generations; terrain irregularities and prolonged degradation, holdings are highly fragmented in Ethiopia. The average number of plots per household ranges mainly from 3-8. The vast majority of the farming households possess less than one hectare of land, with the average land holding dropping to 0.28 ha/household nowadays.

2. Low Use of Inputs

Ethiopian agriculture is characterized by low use of natural and chemical fertilizers. Less than *60 percent* of smallholder farmers used commercial, chemical fertilizers while only *10 percent* used organic fertilizers in *2016.* Thus, only a small proportion of the cropland is fertilized.

4. Susceptibility to Disasters

Agriculture is Ethiopia is highly vulnerable to natural disasters such as drought which affects the lives of millions of humans and animals. The incidence and intensity of disasters has been increasing. Limited soil conservation measures, forest destruction and expansion of agriculture into marginal areas increased the frequency of drought. The natural disasters have usually resulted in famines.

5. Limited practice of irrigation and dependence on rainfed agriculture

Although Ethiopia has vast area of irrigable land, the proportion of cultivated land is so small due to physical (steep slopes and deep gorges, water logging, salinization and siltation….) and human (e.g. capital, technology, skilled manpower etc) constraints. Therefore, there is great

dependence on rain-fed agriculture which renders it highly vulnerable to climatic changes. Over 98 percent of the Ethiopian farmers rely on rain-fed agriculture. Besides, the possibilities of expanding agricultural land under rain- fed practices are limited or are not very high. Additional land that can be brought under rain fed is found in the area stretching from Gambella to Humerra for some 100 kilometres of width occupying the western lowlands of the country. Moreover, this area is drained by major rivers (Baro, Abbay & Tekkeze Rivers) and is potentially suitable for irrigation.

8.5.3. Agriculture Systems in Ethiopia

Agricultural system is defined in terms of similar resource basis, enterprise patterns, household livelihood and constraint; and thus, could have similar development strategies and interventions. Thus, an agricultural system is a practice and a way of life carried by rural people who are confined to relatively similar agro-physical resource basis and share more related socio-cultural, economic and livelihood structures and patterns.

Ethiopia has contrasted (diverse) climatic and soil types which created an ideal condition for the cultivation of different corps and rearing of animals. The farmers have developed complex farming systems and cropping patterns in response to the diversified physical environment.

The agricultural systems of Ethiopia can be classified based on:

- *The Agro-ecological patterns to which the practices have been confined.*
- *Dominant types of crops or animals reared or combinations.*
- *Farming methods and tools used for cultivation, which are a reflection of topographic and climatic influence.*
- *Level of technological input and the disposal of output.*

Based on the dominant corps cultivated or animals reared and the main implements used in cultivation, the following major farming systems are identified:

1. Highland mixed farming system
2. Lowland mixed farming system
3. Pastoral system

4. Shifting cultivation
5. Commercial agriculture

1. Highland mixed farming system

The highland areas of over 1500m.a.s.l are characterized by 'dega' and 'woina dega' agro-ecological zones. The major characteristic feature of the farming activity is the integration of crop and livestock production. Sub components of the system include:

A. Grain-plough complex

It is practiced in the central and northern parts of the country. Farmers mainly depend on cereals for subsistence which are grown along with pulses and oil corps for some commercial purposes. *Barley* and *wheat* dominate in the grain-plough complex of Arsi and Bale, while 'teff' is the most important crop in the central and northern highlands of Shoa and Gojjam. Harvesting is done using family labor or contributed labor from neighborhoods. Crop cultivation is mainly based on crop rotation. The plough is the main agricultural implement; and oxen are principal means of draft power and equines provide the means of transport.

Ploughing is practiced many times (2-6) before planting. Seeds are mainly broadcast on the soil surface and then ploughed in. Livestock rearing is based on unimproved native pasture supplemented by crop residues.

Sustainable agriculture in this system is adversely affected by drought, soil degradation and the practice of removing crop residues for feeding animals and using animal dung for fuel. Since little or no organic matter is added to the soil and conservation-based farming practices (e.g. terracing…) are rare, declining soil fertility necessitates shifts in crop pattern and increased application of fertilizer to obtain high yields.

B. The Horticulture-Hoe complex

This agricultural system is primarily found in the high rainfall humid regions of southern and southwestern parts of the country. The land is cultivated with hoe (human power) for horticultural crops. The major crops grown include '*enset'* (false banana), coffee, chat and various other horticultural corps. In the '*enset'* growing areas, farmers make intensive use of dung. Horticulture crops such as sweet potatoes/sugar beet, lemon, banana, mango, and avocados are widely grown. In some areas draft animals are also used and cereals, pulses are cultivated.

Maize is the major cereal crop of the region grown; and production is favorable and less variable than in the grain-plough complex. In large parts of the Horticulture – hoe complex areas an **Agro – forestry farming system** using *multiple cropping methods* composed of coffee, Chat, Enset, with some tree plants consisting both wood and fruit- trees which are grown inter – mixed on small farm plots. The eastern highlands of Hararghe are also classified as part of the horticulture-hoe complex and sorghum (staple food crop) is often intercropped with corps such as chat and sweet potatoes.

Livestock, mostly cattle, form an integral part of the horticulture hoe system. With increasing population pressure and farmland scarcity, *stall-feeding* has become a common practice. However, in more humid areas, pests and diseases (e.g. tsetse fly) have threatened livestock husbandry.

2. Lowland mixed agriculture

Lowland agriculture is practiced in the mountain foothills and the lower valleys below 1500m.a.s.1. The region is characterized by hot and dry conditions (450-800mm of rainfall) and shallow soils with poor water retention.

Lowland agriculture is common in the Rift Valley and northern areas of Awash River. Drought-tolerant varieties of sorghum, maize, wheat, teff, oil corps and lowland pulses are grown. Livestock are also raised on common grazing land and crop residues. The plough is used in the cultivation.

As a response to the shortage and variability of rainfall, farmers diversify their cropping patterns by growing several crop varieties; shifting to early maturing crop varieties; and drought tolerant ones. In times of serious drought livestock are relied up on for survival. Other sources of income include sale of firewood and charcoal and off-farm employment opportunities.

3. Pastoral complex

This type of agriculture is practiced in the arid and semiarid lowlands of Ethiopia where average annual rainfall is less than 500mm by nomadic and semi-nomadic peoples of Afar, Somali and Borena zone of Oromia and lowlands of the Southern Region of southern Omo and Lake Turkana area. Livestock rearing is the main economic activity in these sparsely populated dry

and vast areas. Cattle, camels, sheep and goats are important animals forming the livelihood of the population. In some lowlands, crops are produced along flood plains and river banks.

Almost all the camels, about ¾ of the goats, ¼ of the sheep and about 20% of the cattle are raised by pastoral communities. About 90% of the live animals exported come from pastoral areas.

A major constraint to animal husbandry in the pastoral areas is shortage of water especially during the long dry season. Overgrazing has also reduced the quantity, quality, accessibility and stability of the resource base. Tropical livestock diseases are also major predicaments to the system. Encroachments by highlanders searching for farmland; and a shift to dry land cultivation by the nomads themselves have restrained grazing opportunities. Range ecosystems are usually fragile because of lower fertility and shallow top soil.

4. Shifting cultivation

This is the cut-and- burn cultivation system whereby a given plot of land is cultivated after clearing until its natural fertility is exhausted to a level it cannot support plant life any longer and then abandoned for another clearing. In Ethiopia shifting cultivation is practiced by some ethnic groups living in western and south western fringes of the Ethiopian highlands and lowlands or Benishangul-Gumuz, Gambella and Southern Regions where population density is low and livestock rearing is limited in some areas due to tsetsefly infestation (trypanosomiasis). The scale of shifting cultivation in terms size of people living by the practice is presently on decline in the country, due to government intervention and settlement (villagization) programs, and the subsequent introduction and sorting the community to sedentary farming.

5. Commercial agriculture

Commercial agriculture is a modern farming practice involving the production of crops or animal products for market by using some degree of mechanization and hired laborers.

It was introduced in the 1960s when the government decided to produce more commercial corps to meet the growing demand for food in the urban areas and agricultural raw materials for industries. Mechanized farms were concentrated in the Awash valley, Arsi, southern Shoa, and Humera-Metema by the time many of which were nationalized (1975) and converted into state farms. New coffee and tea farms were also created during the Dergue. The incumbent government also introduced large-scale sugarcane plantations for the sugar industries.

Currently, the economic reform permitted the participation of the private sector in large scale commercial farming. Investment permits are issued by the Ethiopian investment authority and regional investment offices. However, the main problem faced by investors in agriculture is access to land as it has to be free of other users to be leased to an investor by the regional government. As a result investors need to go to low, hot, disease ridden areas of the south and west to find 'unoccupied' land. Lack of infrastructure is also a major barrier to the profit – motivated commercial farmers. There have been also conflicts with local inhabitants who claim that the land belongs to them that call for sound conflict resolution mechanisms and enhancing livelihood conditions of local communities.

8.5.4. Major problems of Ethiopian agriculture

The Ethiopian agriculture has been characterized by low production and productivity. Despite the existence of a huge agricultural population, the sector failed to satisfy the food needs of the growing population. The major obstacles to the development of this sector include:

Land degradation: because of the rugged topography, about half of the cultivable land of Ethiopia is exposed to various level of soil erosion. The soil in many areas has lost some biological productivity and physical properties needed for optimal plant growth.

Variable rainfall: Ethiopian agriculture is heavily dependent upon unreliable rainfall which may produce surplus only in years of favorable weather. The rain sometimes comes early or late; and at other times it falls short of the required number of falls

Land fragmentation: The increasing population size of rural Ethiopia and the limited total land area, especially, in the high land farming area has been the cause for declining percapita landholding. Studies suggest that on the average, small land holding is less than 1 hectare per household. As the land is too small to produce any marketable surplus under the prevailing conditions, subsistence and survival are the overriding concern of the farmers. This resulted in lack of cash for investment, purchase of commercial inputs and purchase of oxen for land preparation.

Land tenure insecurity: Uncertainty about the possible communalization of land and continuing land redistribution erodes the incentive to invest in permanent conservation and improvement on

individual holdings. Land remains under the ***state control in EPDRF***. And, land is the collective property of the Ethiopian people and is *not subject to buying and selling* deal.

Backward technology: In Ethiopia the smallholder farming is characterized by dependence on traditional tools and farming practices. Land preparing, is done by oxen drown plough; planting is performed by manual broadcasting; weeding and harvesting are performed manually; and threshing is also carried out by animals trampling the harvested crop. Moreover, agricultural produce in transported by primitive means like pack animals and human percentage. Low application of modern inputs fertilizer pesticides, and improved seeds) poor animal breeds etc. also characterize the Ethiopian small holder farming.

Poor rural infrastructure: transport and communication systems area poorly developed. Agricultural output is usually carried long distance by traditional transport means like pack animals or by humans, to sale place. The poor infrastructure has severely hampered socioeconomic development particularly in the rural area.

Other problems that constrain Ethiopian agriculture include, overgrazing, nutrition stress and diminished grazing land area; widespread prevalence of different diseases and parasites; poor genetic structure and lower productivity in terms of growth, yield and reproduction; weak agricultural research and extension; and capital constraints of peasants required for investment in their farms among others

Review Questions

1. State the agricultural resource base of Ethiopia
2. List down the major farming systems of Ethiopia.
3. List the most important contributions of the agricultural sector in Ethiopia.
4. What are the major constraints facing small-scale farmers in earning their livelihood?

8.6. Manufacturing Industry in Ethiopia

8.6.1. Introduction

Industrial development in Ethiopia is extremely backward. The contribution of the industrial sector to the Gross Domestic Product (GDP) over recent periods is only 11.7 percent. The backwardness of the industrial sector is an indication of the low-level development of the Ethiopian economy. In the modern world development is equated with industrialization.

Manufacturing is a process of changing commodities to consumable forms. In this process there is an addition of value. In other words, the value of commodities is more after the undergone manufacturing. Manufacturing is, therefore, a higher-level economic activity than the production of primary materials.

Employment in Industries

The total number of persons employed by various manufacturing industries was reported as over 329,000 in 2015/16 (Figure 8.2). This represents a continually increasing trend in the number of employees working in all industries over the last five years. But there is as yet no clear pattern to the availability of jobs by industrial group. Textiles and garments increased from 2011/2012 to 2013/2014, but then declined. The number of persons engaged in machinery and equipment grew tremendously from 2012/2013 to 2013/2014, but then contracted just as rapidly to 2014/2015.

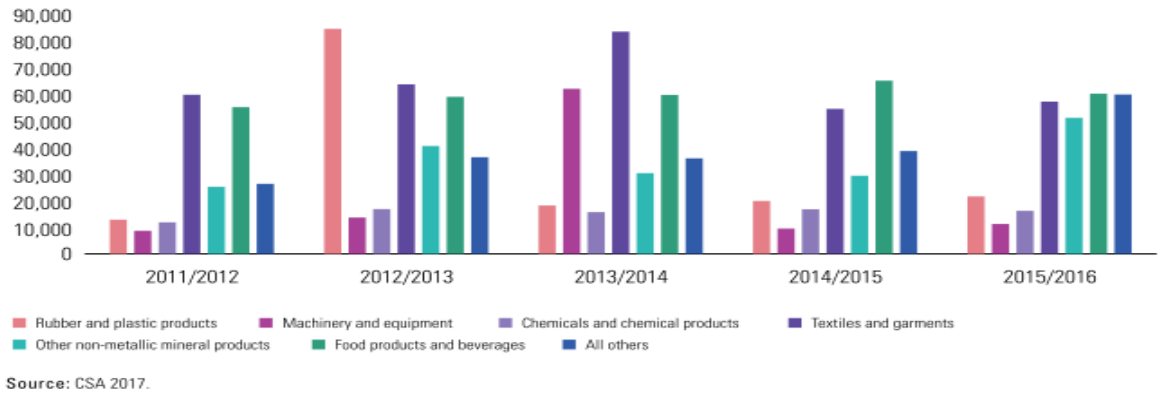


Figure 8.2: Number of persons employed by major industrial Group-Public and private (2011/12-2015/16)

The employment distribution of the different firm size within the manufacturing sector indicated that micro enterprises employ 138,951 (51%); small enterprises employ 10,960 (3.9%); medium enterprises employ 14, 757 (5.4%) and large enterprises employ 108,226 (39.7%) in 2007/08 alone.

The value of industrial production

Gross value of production by manufacturing sector worth about 113 billion Birr in 2012/13 and value added generated is estimated to reach 32 billion Birr in the same year, which was about 4% of the value addition to the entire economy in the same year. It was also indicated that, the largest value addition came from the *food and beverage* subsector, which was around 8 billion birr in 2012/13, followed by *non-metallic mineral* subsector (4.3 billion Birr) and *metal and engineering* subsector (3.9 billion Birr) while the smallest contribution came from *textile* and *apparel* industry (396 million Birr). The Ethiopian large and medium size manufacturing sector is dominated by food and beverages. It accounted for the largest proportion of the overall large and medium manufacturing value added between 2000/01 and 2010/11.

8.6.2. Types and characteristics of manufacturing

Types of Manufacturing Industries

It is possible to identify two types of industries in Ethiopia. These are the traditional or cottage industries and the modern manufacturing industries.

- **The Cottage (traditional)industries**

Cottage industries have a long-standing place in Ethiopian history. Though the time of their inception is not clearly known, various kinds of weaving, woodcarving, pottery, metal works, basketry etc. are known for a long time.

A peculiar feature of the cottage industries in Ethiopia is that they remain static; i.e., they existed with little changes and refinement throughout their long period of existence. The major factor for this phenomenon is the negative traditional attitudes towards such activities, which prevailed among various Ethiopian communities. The activities were considered of low social cast activities. People engaged in such activities were despised and were given various pejoratives such as "buda" "faki" etc. The people were not encouraged to refine their products.

This is probably the most important factor in retarding the pace of development of the cottage industries.

Other than the aforementioned factor other factors include the limited availability of the factors of industrialization such as minerals, market, agricultural raw materials and sources of power, which are the basis for industrial development.

❖ **Manufacturing Industries**

The development of manufacturing activities is measure of the development stage of countries. In Ethiopia manufacturing industries are at a low level of development. Most of the manufacturing industries are light industries i.e. industries that process consumer goods like textiles, food, tobacco etc. Heavy industries that manufacture capital goods are very small.

Industrial development in Ethiopia is extremely backward. The contribution of the industrial sector to the Gross Domestic Product (GDP) is only 11.7 percent over the recent period (Table.8.5). The major contribution to GDP of the country comes from agriculture and service sector. Further, specifically looking at the performance of manufacturing remains a cause for concern as its contribution to GDP not only remained low but also contracted slightly from about 6% of GDP during 2000-04 to about 4% during the 2010-2014. Despite the attention given to manufacturing in the GTP plans, the sector is not expanding as expected.

Table 8.4: Gross Domestic Product by Sector

Year	Agriculture	Industry	Manufacturing	Service
1980-84	55.8	9.6	4.7	34 .6
1985-89	52.8	10.7	4.9	36 .5
1990-94	59.5	8	4 .0	32.5
1995-99	53.6	11.7	6 .1	34 .6
2000-04	43.5	13.3	6 .1	43.2
2005-09	46.6	11.8	4.7	41.6
2010-14	44 .9	11.7	4 .0	43 .4
Average	51	11	4.9	38.1

Source: World Development Indicators (2015)

Note: The share of industry in GDP includes that of manufacturing.

The existing industrial establishments in Ethiopia are few in number and most of them lack capital and have low productive and job creation capacity. Besides, most of the industries rely on agriculture raw material for production.

8.6.3. The Spatial Distribution of Manufacturing Industries in Ethiopia

Historically, manufacturing establishments have been concentrated in a few large towns. In 1995/96 the top ten towns accounted for about 85 per cent of the total number of establishments and 79 per cent employment; where in the same year Addis Ababa alone accounted for about 67 per cent and 60 per cent respectively. This concentration has shown a modest decline and in 2009/10 the top ten towns share reached 60 percent and 62 per cent of the total number of MLSM establishments and employment respectively. The share of Addis Ababa also correspondingly declined to 40 per cent and 46 per cent respectively in the same year. New industrial towns such as Burayu, Sululta, Sebeta, Mojo, and Ambo are emerging around the capital city. Four of these were among the top ten industrial towns in both 2003/04 and 2009/10. This brings the concentration in Addis Ababa and the surrounding towns (in a 100 km radius), for example in 2009/10, to above 48 per cent (number of establishments) and 52 per cent (in terms of employment).

Some of the current regional capitals such as Hawassa in the south, Dire Dawa in the east, Mekelle in the north, and Bahr Dar in the northwest are also among the top ten towns hosting a substantial number of industrial establishments. The gap between the first and the next top-ranking towns is, however, very large. For example, in 2009/10, the first top town (Addis Ababa) hosted about eleven times more manufacturing establishments than the second largest industrial concentration town (Hawassa).

Table 8.5: Geographical distribution of Manufacturing enterprises

Top 10 towns share (%) 1995/96			**Top 10 towns share (%) 2003/04**			**Top 10 towns share (%) 2009/10**		
Top 10 towns	# of est.	Employment	Top 10 towns	# of est.	Employment	Top 10 towns	# of est.	Employment
Addis Ababa	67.2	60.4	Addis Ababa	55.8	53.6	Addis Ababa	40.3	45.9
Dire Dawa	4.0	7.0	Hawassa	3.3	2.8	Hawassa	3.6	2.5
Bahr Dar	2.6	3.3	Mekelle	3.0	1.7	Dire Dawa	2.8	1.9
Awassa	2.4	3.2	Bahr Dar	2.3	2.6	Mekelle	2.8	1.9
Adama*	2.3	1.5	Burayu*	2.2	1.4	Adama*	2.4	3.1
Jimma	1.9	0.4	Dire Dawa	2.2	3.9	Bahr Dar	2.3	1.4
Mekelle	1.6	0.3	Adama*	2.2	1.7	Bisheftu*	1.7	2.5
Besheftu*	1.1	1.2	Besheftu *	1.9	2.8	Sebeta*	1.7	1.5
Harar	1.1	1.3	Sebeta*	1.7	1.7	Burayu*	1.6	1.3
Dessie	1.0	0.3	Dessie	1.5	0.4	Hosana	1.1	0.3
Top 10 towns	85.2	79.1		76.3	72.6		60.5	62
Sum (%)								
Total	622	91,096		982	104,681		2,172	186,978

*Source: Mulu Gebreeyesus, 2016*Note: (*) Indicates towns fewer than 100 km from Addis Ababa.

Looking at the current spatial distribution of industries similar trends is observed over the recent period where industrial distribution and activities concentrate in specific regions. The total number of large and medium scale manufacturing industries reported in 2015/16 was 3,596. About 37 percent of the manufacturing industries were located in Addis Ababa followed by Oromia with more than 27 percent and Tigray with about 14 percent of the industries. Many of the industries in Oromia are located around Addis Ababa.

There could be many reasons as to why industries concentrate in and around specific towns and regions in the country. The agglomeration of industries in towns and specific regions mentioned above is explained by the availability of infra-structural facilities. In the case of the Addis Ababa-Adama industrial area, the Addis-Djibouti railway, proximity to the port of Djibouti, and availability of social service facilities are important. The railway and the development of infrastructure in the area explain the relatively higher concentration of industries around DireDawa. Political decisions could also influence the spatial distribution of manufacturing industries. The question of industrial location and regional

equity requires a complex planning activity involving correct location policies and resource availability, each of which must be based on thorough and interdisciplinary examination.

Industrial parks/zones in Ethiopia

The agro-processing industries, leather products and the textile and apparel sectors have been designated as top priority manufacturing industries in the latest five-year development plan (2015 to 2020). The main reasons include:

i. strong linkages with the agricultural sector as they use inputs from the livestock and cotton sectors,
ii. they are also both labour intensive, thus absorbing labor from the agricultural sector, and
iii. they have major export potential and low entry barriers. To unleash these supportive industries, the government established industrial parks across the country to cluster these industries

The development and construction of industrial parks started in 2014 when the Ethiopian Industrial Parks Development Corporation (IPDC) was established. It gained momentum in 2015 with the Industrial Parks proclamation 886/2015. Three mechanisms are in place for the establishment of IPs/SEZs:

a. fully developed by the federal or regional government;
b. developed by PPPs with the IPDC and
c. by private developers only.

Industrial parks in Ethiopia can also be categorized based on their focus sector;

- Textile and garment;
- Leather and shoes
- Agro-processing,
- Pharmaceutical and IT park. (see the detail description on Table 8.6).

Table 8.6. Distribution of Industrial parks (IPs) and Zones in Ethiopia

No	Name	Location	Main industry
	Federal Development Park		
1	Bole Lemi Industrial Park	Addis Ababa	Garment
2	Hawassa Industrial Park	SNNPR	Garment

3	Mekele Industrial Park	Tigray	Garment
4	Kombolcha Industrial Park	Amhara	Garment
5	Jima Industrial Park	Oromia	Garment
6	Adama Industrial Park	Oromia	Assembling, garment, food
7	Bole Lami Industrial Park II	Addis Ababa	Garment
8	Kilinto Industrial Park	Addis Ababa	Pharmaceutical, medical equipment
9	Dire Dawa Industrial park	Dire Dawa	Assembling, garment, food
10	Bahir Dar Industrial park	Amhara	Garment
11	Arerti Industrial Park	Amhara	Construction products, home appliance
12	Debre Birhan Industrial Park	Amhara	-
13	Aysha Industrial Park	Somali	-
14	Airline and logistics parks 4	Addis Ababa	Transportation
15	Addis Industrial Village 5	Addis Ababa	
16	Modjo Leather City	Oromia	Leather
Regionally Developed parks			
1	Bure Integrated Agro-Industrial Park	Amhara	Agro-processing
2	Bulbula Integrated Agro-Industrial Park	Oromia	Agro-processing
3	Yirgalem Integrated Agro-Industrial Park	SNNPR	Agro-processing
4	Baeker Integrated Agro-Industrial Park	Tigray	Agro-processing
Private parks			
1	Eastern Industrial park	Oromia	Various
2	Huajian Light Industry City	Addis Ababa	Shoes, garment
3	Modjo George Shoe Industrial Park	Oromia	Leather
4	Kingdom Linen Industry Zone	Dire Dawa	Linen

Source: UNIDO, 2018 *NB: some of the parks are under construction*

Contributions of Industrial Parks in Ethiopia

- Stimulating investment and creating employment
- Facilitating export growth and foreign exchange earnings
- Developing industrial clusters through forward/backward linkages
- Eliciting knowledge transfer and technology spill over
- Establishing connections to global value chain
- Fostering Sustainable Growth and social equality
- Enforcing implementation of national industrialization strategy

The Sugar Sector Mega Projects in Ethiopia

Sugar Industry is one of the industries which contribute immensely for the industrial transformation of our country. The country has huge labor and resources like water, suitable climate and ideal landscape to expand this export-oriented manufacturing industry. Ethiopia has favorable climate for sugarcane development. It also has more than 500 thousand hectares of irrigable land suitable for the sector. Moreover, it has abundant untapped water resource. These make the sector seek more attention and a coordinated effort

Until recently, Ethiopia has been a net importer of sugar as the two old sugar factories (Wonji and Metehara) have limited capacity to meet domestic demand. Cognizant of the existing limited capacity observed in the two factories, the government of Ethiopia is heavily investing in sugar production. One of the targets of the first Growth and Transformation Program (GTP I) was to expand the sugar sector with the ambition for Ethiopia to become one of the top ten sugar exporters in the world. This plan involved the construction of ten large sugar plantations and factories like Omo-Kuraz Sugar Factory II, Kessem , Arjo Dediessa, Tendaho, Finchaa, Metehara, Wolqayet Sugar development project, Tana-belese Sugar Factory II etc. However, work on the construction of the major sugar factories is delayed and yet to be completed.

8.6.4. Industrial development in Ethiopia: Challenges and Opportunities

Ethiopia has adopted different policies for the development of industry over the past century. The industrial policies have distinctive features when looking at the guiding vision (policy), ownership structure, and market orientation. Broadly, they can be characterized as the import substitution and private sector-led (from early 1950s to 1974); the import substitution and state-led (from 1974 to 1991), and the export-orientated and private sector-led from 1991.

Challenges of the Manufacturing Sector

Ethiopian's industrial base and economic development are the lowest even by African standard. There are various constraints to the country's industrial development. However, the potential for industrial development is also enormous. The constraints and opportunities for industrial development are indicated as follows:

Challenges and opportunities of industrial development in Ethiopia

Challenges	**Opportunities**
High logistics and transportation cost	Relatively cheap electricity charge in comparison to other African countries
Limited research/study and action on export incentives and market	Macroeconomic stability and rapidly growing economy
Low labor productivity	Relatively cheap labor force & increasing number of trained employees
High cost of imported raw materials	Access to wide market (large domestic market, COMESA, AGOA, EBA opportunities, China market etc.)
Limited compliance to the international requirements and market	Competitive incentive packages which include export incentives
Underdeveloped rural infrastructure in the potential areas	Integrated Agro-Industrial Parks (one stop shopping for all the services, economies of scale, extension services, development of common infrastructure)
Weak supply chain integration, market institutions and information system	Global attention due to its remarkable economic growth and credit worthiness
Low level of technology	

Review Questions

1. What is manufacturing?
2. How important is manufacturing to the development of Ethiopia?
3. What are the major constrients of the development of the manufacturing sector in Ethiopia?
4. How important are the industrial parks to the development of manufacturing industries in Ethiopia?

8.7. The Service Sector in Ethiopia

8.7.1. Introduction

Tertiary economic activity involves the distribution and provision of goods and rendering services. Tertiary institutions include wholesale and retail outlets, banking and other financial services, governmental and educational services, medical facilities, and much other business and service functions upon which we depend daily. Security services, transportation, information and telecommunication services, tourism, health services, education institutions and research centers all are vital tertiary economic activities. In this section, discussion will be made on the three of the service activities in Ethiopia: transportation and communication, trade and tourism.

8.7.2. Transportation and communication in Ethiopia: types, roles and characteristics

8.7.2.1. Transportation

Transportation is a service or facility by which persons, manufactured goods, and property are physically carried from one location to another. Transportation is fundamental to civilization. Transportation, it is usually said, is the lifeline or the blood vessel of an economy. This is why we invariably see a well-developed transportation network in well-developed economies.The role of transportation in socio-economic development is that it allows for: division of labor and labor specialization, procurement of raw materials from various sources, dispatch of goods to market places and personal mobility etc.

There are five different types of transport in Ethiopia. These are:

a. Traditional Transport:

This includes the use of pack animals (donkeys, mules, horses, camel) and goods carried by humans. The contribution of these means of transport to the national economy is not known in statistical terms. In rural Ethiopia where modern transport systems are very few, it is obvious that they make immense contributions. Even in urban areas like Addis Ababa, modern meansof transport has not totally done away with the traditional means.

b. Road Transport

Today most passengers and goods in Ethiopia are transported by road transport. In Ethiopia road transportation is relatively a recent phenomenon. Italians basically started it during their period of occupation. These roads were essentially built for military movement purposes. In other words, they were not built for the purpose of economic integration of the country. Later on, with Addis Ababa growing as the political center of the country, the roads built in subsequent periods were constructed for administrative connections. The radial patterns of network development with the center being Addis Ababa, exhibits administrative integration rather than economic integration. This, however, does not mean that the roads were not used for economic purposes.

i. Road Network

Data obtained from the Ethiopian Roads Authority showed that during 2004/05 classified road network in Ethiopia was 37,018 km while the total road network increased rapidly and reached 126,773 km during 2017/18 (this includes 35,958 km rural road (28.3%). (seeTable 8.7)

Table 8.7: Length of all-Weather Roads by Type(2004-2017)

Year	Federal Road		Rural road	Total**
	Asphalt	Gravel		
2004/05	4,972	13,640	18,406	37,018
2005/06	5,002	14,311	20,164	39,477
2006/07	5,452	14,628	22,349	42,429
2007/08	6,066	14,363	23,930	44,359
2008/09	6,938	14,234	25,640	46,812
2009/10	7,476	14,373	26,944	48,793
2010/11	8,295	14,136	30,712	53,997
2011/12	9,875	14,675	31,550	63,083
2012/13	11,301	14,455	32,582	85,966
2013/14	12,640	14,217	33,609	99,522
2014/15	13,551	14,055	30,641	110,414
2015/16	14,632	13,400	31,620	113,066
2016/17	15,886	12,813	33,367	120,171
2017/18	15,886	12,813	35,985	126,773

Source: National Bank of Ethiopia,2017/1

ii. Road Density

The rugged terrain in Ethiopia makes road construction difficult and expensive. If we compare the length of roads to the total area of the country, we observe that it serves a small area. One-km road serves an area of about 66 km^2. If we generously assume a distance 10 kms on either

side of a road as being accessible only about 370, 000, km^2 area or 30 percent of the country is accessible. In many cases roads assume the purpose of connecting nodes or places forgetting the people and the economy in the hinterland or in between the nods. The road density/1000 persons was 0.5 in 2004/5 that increased to 1.27 in 2017/18. Likewise the road density/1000square kilometer was 33.7 in 2004/5 that improved in a way to 115.2 in 2017/18.

Although the road network has shown an increasing trend, the progress so far is still far below the need compared to the large land area and population of the country. Network distribution per thousand sq. km and per million people is only 115.2 km and 1.3 km, respectively. This makes the country one of the least accessible in Sub-Sahara Africa.

iii. Road accessibility

In 2016/17, annual average distance from all-weather roads declined by 6.5 percent from 4.6 km in 2015/16 to 4.6 km. Similarly, the proportion of area more than 5 km from all-weather roads dropped to 33.5 percent from 31.6 percent last year. By 2019/20, it is envisaged to narrow the proportion of area more than 5 Km from all-weather road to 13.5 percent (Table 8.10).

c. Railway

The major advantage of rail transport is that it helps transport bulky products. For more than a century, Ethiopia was served by an international meter gauge railway, from Addis Ababa to Djibouti City in Djibouti. The railway was built from 1897–1917 and was about 781 km long primarily served to move export- imports for a long time. Compared to those of the developed countries the railway was backward. It was also a single lane track. Eventually the Ethio-Djibouti Railway and its decades old rolling stock was lacking spare parts and forced to closed down over a number of years.

Recently a new railway line of 750 km length connecting Addis Ababa to Djibouti, was officially inaugurated in Djibouti in 2018. The Addis Ababa–Djibouti Railway is a new standard gauge international railway that serves as the backbone of the new Ethiopian National Railway Network. It provides Ethiopia with access to the sea, linking Addis Ababa with Djibouti and its Port of Doraleh. More than 95% of Ethiopia's trade passes through Djibouti, accounting for 70% of the activity at the Port of Djibouti.

The other important railway is Addis Ababa Light Rail Transit. It is the first light rail and rapid transit in eastern and sub-Saharan Africa. The total length of both lines (north-south and east-west) of the rail is 31.6 kilometres (19.6 mi), with 39 stations. The rail project was constructed by China Railway Engineering Corporation Limited (CREC) and is currently operated by Chinese firm Shenzhen Metro Group Company. It is estimated that AALRT currently transports about 60,000 people daily, significantly reducing traffic congestion in the capital, Addis Ababa.

d. Waterways

Waterways are two types. These are seaways and inland waterways. When we talk of seaways we are talking about open areas. Ethiopia being a landlocked country does not have direct access to such areas. Presently, the Red Sea through the port of Djibouti is very important for Ethiopia's external trade. Inland waterways are classified in to two i.e., rivers and lakes. Because of the nature of the topography over which Ethiopian rivers flow, Ethiopian rivers with the exception of Baro and Omo in their lower courses, cannot be used for transportation. On some of the lakes like Tana and Abaya there is small-scale transportation. The contribution of inland waterways to the Ethiopian economy is very small.

e. Airways

The other transportation mode, fairly recent in appearance and modern in its constitution, is air transport. Air transport is the fastest means of transportation from one place to the other. It has reduced distances by minimizing the travel time. It is very essential for a country like Ethiopia, where the topography is difficult for communication. There is no problem of laying the track for airways. The problem with air transportation is that they are expensive and cannot be used for transporting bulky products. EAL serve some forty-five cities and towns in the country. The reputed Ethiopian Airlines also gives impressive international service.

8.7.2.2. Communications

Communication is the process of conveying messages to others. An effective communication system plays a vital role to: accelerate the pace of development, enhance closer social integration, and to promote the basic aim of economic activities. Some of the communication services that are commonly used in Ethiopia include radio, television, internet, satellite, print publications, fixed and mobile telephones, and post offices. Microwave radio; open-wire; HF,

VHF, UHF radio communication services; and satellite contribute to the domestic telecommunications system.

The Contribution of Transportation and communication to Socio-Economic Development

The contribution of transportation to a country's development is high. Its share of contribution to the GDP of a country is incontrovertible, though the nature and extent of the contribution varies from country to country. Transportation plays important economic, social and political roles some of which are indicated hereunder:

- It creates job opportunity
- It promotes investment sector - on infrastructure development.
- Transportation plays a big role for both national and international trade.
- It serves as a source of income generation both for governments and the public;
- It contributes to the maintaining a country's peace, political wellbeing and stability;
- Plays the role of linking rural areas and rural products to urban centers and helps in increasing and interconnecting market outlets;
- Makes big contribution to the development of tourism, entertainment, sports and peaceful relationship among people.

Although the expansion of the transport sector is of tremendous economic, social and political benefit, there are nevertheless some negative aspects to it. The fact that its energy consumption is high, that it is foremost among the factors that contribute to environmental pollution, that it has been classified among the world's killer diseases with regard to traffic accidents, and that it has become a source of anxiety in terms of congestion constitute the negative side of the transport sector.

8.7.3. Trade in Ethiopia

Trade is a process of exchange of products involving change in ownership of commodities. The development of trade in a country depends on the development of production activities. Trade basically arises when regions or persons complement one another with their products. A country carries out two types of trade. These are *internal trade and external trade*.

Internal trade: This refers to the exchange of goods and services within the country. It can be done between regions or within a region.

External Trade: External trade refers to the exchange conducted between countries. In other words, it is concerned with import-export trade.

Foreign Trade

The main reason that necessitates trade with one another rather than running completely independent economies is that, the earth's resources are not equally distributed across its surface. That means different countries have different factor endowments, and the international mobility of these factors is severely limited. Some countries are rich in capital resources, others are rich in labor resources, and still others are rich in natural resources. Hence, every country must trade with others to acquire what it lacks.

Structure of Commodity Export of Ethiopia

As the Ethiopian economy is an agrarian economy its merchandise (visible) export is determined by agricultural products. According to the data from National Bank of Ethiopia/NBE/, for all study periods the export structure of Ethiopia has been characterized by greater concentration of few traditional exports such as *coffee, oil seeds, and pulses and chat*. *Coffee* dominates the total merchandise export item of the country and accounts for 29.5% of visible export earnings. Oilseeds accounting for 14.9 % take the second position followed by pulses 9.5 %, and chat 9.5 % (Table 8.9).

Table 8.9: The share of export items in the total merchandise export value

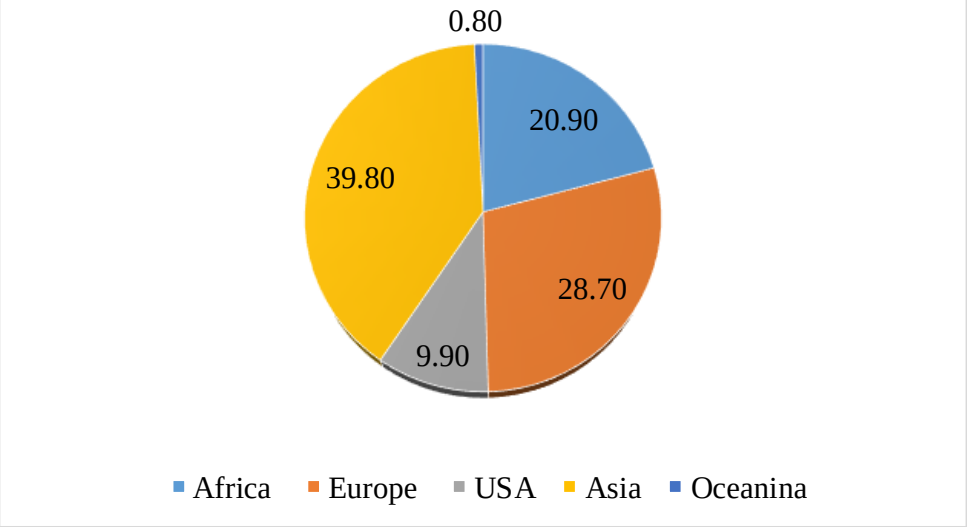
Particulars	2015/16	2016/17	2017/18
	%share	%share	%share
Coffee	25.2	30.4	29.5
Oilseeds	16.6	12.1	14.9
Leather and Leather products	4	3.9	4.7
Pulses	8.1	9.6	9.5
Meat & Meat Products	3.4	3.4	3.6
Fruits & Vegetables	1.9	1.9	2.2
Live Animals	5.2	2.3	2.2
Chat	9.2	9.4	9.3
Gold	10.1	7.2	3.5
Flower	7.9	7.5	8
Electricity	1.1	2.5	3
Others	7.4	9.7	9.7
Total Export	100	100	100

Source: National Bank of Ethiopia, 2018

The Geographic Structure of Exports

Alike the commodity structure, the country's exports has been concentrated geographically with largest proportion of exports destined to limited markets. The major export destinations for Ethiopian goods show that **Asia** accounted for 39.8 % of Ethiopia's export earnings followed by **Europe** (28.7%). On the other hand, about 20.9 % of Ethiopia's export earnings originated from markets in **Africa**. (Figure 8.3)

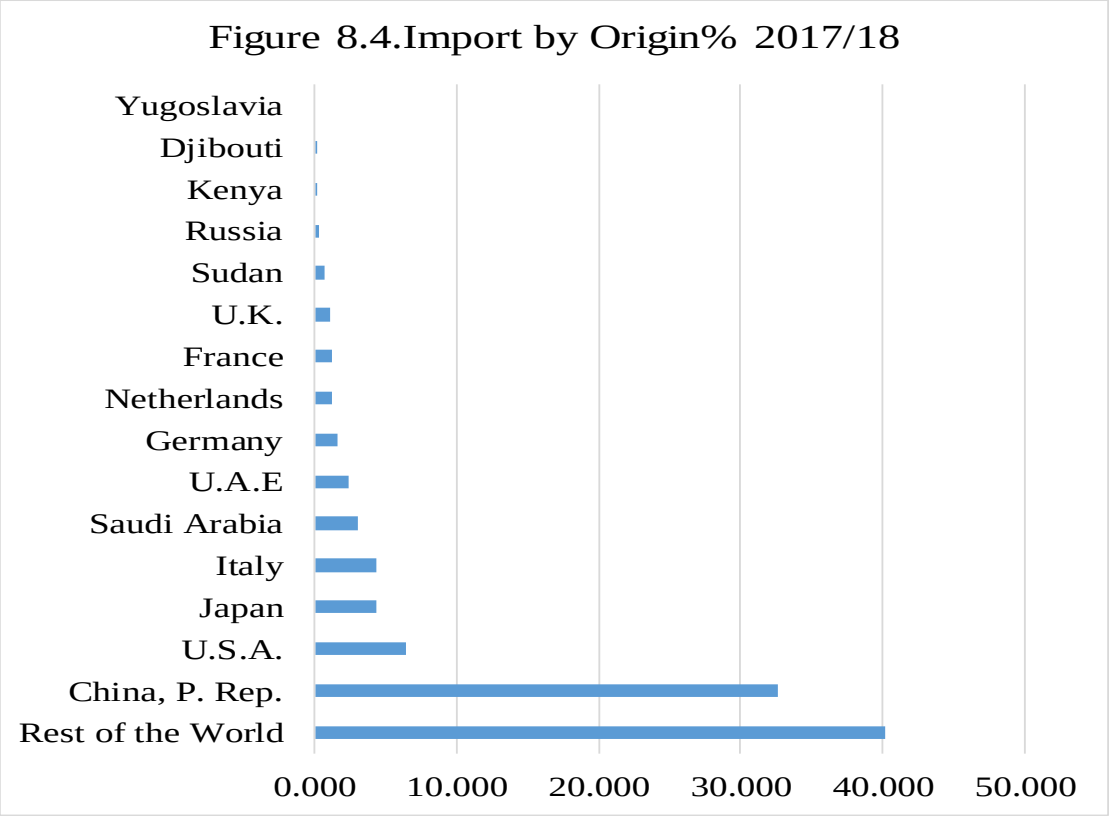
Figure 8.3.Export by destination, 2017/18



Source: Author Compilation

Looking at the direction of trade by individual country, five countries (China, USA, Netherlands, Saudi Arabia and Djibouti) are important which account for 39% of the Ethiopia's export between in 2015/2016.

With regard to imports of goods, during 2017/18, Asia accounted for 64.2 percent of the total imports of Ethiopia followed by Europe (19.3 %).Ethiopia's total imports with the U.S.A accounted for 9.4 percent of the total import bill. About 51% of Ethiopian's merchandise import originated from china, U.S.A, Japan, Italy, and USA (Figure 8.4).



Source: Author compilation

8.7.4. Tourism in Ethiopia: Types, major tourist attraction sites, challenges and prospects

UNWTO (2002) defined tourism as

> *"Tourism comprises the activities of persons traveling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business and other purposes. "*

Tourism is one of the largest and most important industries in the world in terms of employment creation and generation of foreign revenue. As a worldwide export category, tourism ranked fourth in 2013, after fuels, chemicals, food, and ahead of automotive products

As one of the developing countries, Ethiopia and its tourism is becoming an important sector contributing a great deal towards the social, cultural, and economic development aspects of the country. Though tourism development is still unsatisfactory, international tourist arrivals in

Ethiopia have shown a considerable growth. Likewise, the contributions of tourism income to GDP as well as export earnings are growing in recent years.

Types of Tourism

Ethiopia is endowed with unique landscape, paleontological, archaeological, historical and living cultural tourism attractions. Based on these attractions diverse types of tourism are there in the country. The common tourism forms in the country include living culture tourism, history tourism, archaeology tourism, palaeontology tourism, park tourism, geo-tourism, agro-biodiversity and coffee tourism, rural tourism, conference tourism and sport tourism are

Major Tourist attraction sites of Ethiopia

Historic Attraction sites

i. **The Obelisk of Axum:** preserves an ancient history of the era of the Axumite powerful empire having trade links as far as India and China. Visitors will enjoy the sites of these monolithic obelisks and many more wonders surrounding their history, notably the Bath of the Legendary Queen of Sheba and archeological findings that depict the way of life of the Axumite period that reigned from pre-Christ times up until the 11th century AD.

ii. **The Churches of Lalibela- the** UNESCO has named the rock-hewn churches of Lalibela as the 8th wonders of the world. Lalibela presents the site of a chain of rock carved out 11th century churches with astonishing architectural designs and interior decorations. Ahistorical myth narrates King Lalibela; on his own (with the help of angels) completed the construction of the churches. After his death the king has been designated as an Ethiopian saint.

iii. **The Castles of Gondar-** built in the mid-17th century together with the surrounding centuries-old churches depict yet another sophisticated architectural wonders. The Castles are found in the city of Gondar, which has been the seat of government following Axum and Lalibela.

iv. **The Walls of Harar-** built in the early 16th century, the walls are designated after the city of Harar. The Walls have 5 arched gates inviting to the city's popular basketworks,

variety of fruits and colourfully decorated costumes of Hararie women.The city of Harar is considered as the 4th holy city of Islam.

Natural Attraction sites

i. **The Blue Nile Falls-** locally known as Tississat, meaning 'water that smokes' presents a spectacular water fall with an intense gash from more than forty-five meters (150feet) peak, producing rainbows across the gorge. The area is also inhabited with fascinating wild lives and birds.

ii. **Simien Mountains-** Simien mountains are home of Ethiopia's highest peak Ras Dashen with the height of 4,620 meters above sea level. With the assistance of a professional guide, the area is ideal for mountain trekking. The endemic Walia Ibex and the Gelada baboon are also found here.

iii. **The Rift Valley Lakes-** Ethiopia is one of the countries that the Great Rift Valley system traverses. The Valley embraces the beautiful chains of lakes with abundant wildlife and variety of birds. The Rift Valley comprises famous natural parks known as Abijatta-Shalla, Nechisar, Mago and Omo national parks. Each national park presents a unique feature for bird-watching, trekking and wild life scenery.

iv. **The National Parks:** Being a land of diverse geographic settings and rich natural resources, National Parks in Ethiopia, present spectacular visiting opportunities for tourists that are keen on admiring and enjoying nature.

The Role of Tourism in the Economy of Ethiopia

The direct export earnings generated by tourism in Ethiopia are increasing, and tourism seems to be the third source of export revenue after agriculture and industry.

International tourist arrivals have been on a growth trajectory since the 1990s rising from 64,000 in 1990 to 681,249 in 2013. This has been matched by growth in the contribution of the travel and tourism sector’s direct contribution to the country’s GDP which in 2017 was 2.7%, and is expected to grow by 6.7% per annum reaching 6.1% of GDP by 2028.

Further, the industry is now an important source of employment accounting for 2.4% of total employment in 2017 representing 604,000 jobs directly and this is forecast to grow by 1.9% per annum in 2028 to 742,000 jobs (2.1% of total employment). Such performance has seen the tourism industry increasingly becoming an important economic sector in the country.

Challenges of the sector to be addressed

Ethiopia's possession of varied attractions is regarded as an opportunity for the sector. However, at present, the following major challenges are also confronting the sector:

- Weak institutional framework and implementation capacity, skilled human resources and financing
- Very limited accommodating capacity of international standards for leisure tourism, with investment concentrated in main cities and business-type hotels
- Lack of basic and IT infrastructure present challenges for tourism businesses
- Narrow product range offered to the market by incoming operators
- Weak private sector associations
- Unplanned destination development
- Poor visitor management in natural and heritage sites puts sites at risk
- Poor tourism statistics

Ethiopia has a wealth of natural and cultural resources, with some unique cultural and natural features that set it apart from other African destinations. Current international trends in world markets present opportunities to diversify the product portfolio and attract more visitors, and international markets were prioritized by the *Marketing and Branding Strategy* as being among the 'core' markets with high revenue potential and high affinity for leisure travel to Ethiopia, as well as among the 'steady markets' that are easier to penetrate.

Review Questions

- Identify main transportation systems of Ethiopia.
- Describe the contributions and challenges of transport to the Ethiopian economy
- What are the reasons for poor development of water transport in Ethiopia?
- List down tourist attraction sites recognized by UNISCO.
- Explain briefly the contributions and challenges of tourism in Ethiopia.

References

Addis, E. (2014). *International Migration in Ethiopia: Challenges and Opportunities. In A.In A.Bariagaber (ed.). International Migration and Development in Eastern and Southern Africa.* Addis Ababa: Organization for Social Science Research in Eastern and Southern Africa.

Adugna, A. (1987). *The Population of Ethiopia.* Addis Ababa University.: IDR.

Aherns, C., & Henson, R. (2019). *Meteorology Today. An introduction to Weather, Climate, and the Environment.* Bosto, USA: Ceanage Learning.Inc.

Altes, C. (2018). *Analysis of Tourism Value in Ethiopia.*

Assefa, M.J. . (2014). *Research Journal of Agriculture and Environmental Management*.

Bekele, A. (2007). *Useful Trees and Shrubs for Ethiopia: Indication, Propagation and Management of 17 Agro climatic Zones* . Kenya: RELMA in ICRAF Project.

Bekure, W. ((1982, 83).). *Unpublished Teaching Material for the Geography of Ethiopia.*

Bekure, W. (1981). *Some Spatial Characteristics of Peasant Farming in Ethiopia.*

Berhanu, B., Seleshi, Y., & Melesse, A. M. (2014). *Nile River Basin.* Switzerland : Springer International Publishing.

Bililegn D. (2016). *Unpublished Teaching Material prepared for Economic Geography of Ethiopia.* Hawassa: Hawassa University.

Newton C., A. (2007). *Forest Ecology and Conservation: A Handbook of Techniques.* New York: Oxford Univrsity Press.

CSA. (1997). *FDRE Ethiopia: Statistical Abstract.* Addis Ababa.: CSA.

Central Statistical Agency. (2016). *Agricultural sample survey Key findings.* Addis Ababa: CSA.

CSA. (2017). *2016 Ethiopia Demographic and Health Survey Key Findings. .* Addis Ababa, Ethiopia, and Rockville, Maryland, USA.CSA and ICF.: Central Statistical Agency (CSA) [Ethiopia] and ICF. 2017.

CSA. (2017). *Ethiopia Demographic and Health Survey 2016. Addis Ababa. Available from: https://dhsprogram.com/pubs/pdf/FR328/FR328. pdf.* Central Statistcal Agency.

Daneil, G. (1977). *Aspects of Climate and Water Budget in Ethiopia.* Addis Ababa: Addis Ababa University Press.

EMA. (1988). *National Atlas.* Addis Ababa.

Emnet Y., Kassaye A. & Solomom C. (2012). *Economic Geography of Ethiopia: Teaching Module.* Jimma: Jimma University.

Engles, J., Hawkes, J., & Worede, M. (2002). *Plant Genetic Resource of Ethiopia.* Addis Ababa, Ethiopia: Cambridge University Press.

European Comission. (2015). *A Study on Smuggling of Migrants: Characteristics, Responses and Cooperation with Third Countries.* Brussels: European Commission.

FAO. (1984). *Assistance to Land Use Planning. Provsional Soil Association Map of Ethiopia (1:2,000,000).* Addis Ababa.

FAO. (2015). *Fisheries and Aquaculture Department. 76-85.*

Gebreeyesus, M. (2018). *Industrial policy and development in Ethiopia.*

GSE. (2019, August 27). *Geological Survey Ethiopia (GSE).* Retrieved from GSE: http://www.gse.gov.et/index.php/2016/08/19/about-ethiopia/#

ICMPD. (2008). *International Centre for Migration Policy Development: East Africa Migration Route Initiative Gaps & Needs Analysis Project Country Reports: Ethiopia, Kenya, Libya. Vienna.*

International Labour Organization. (2013). *Global Employment Trends, International Labour Office, Geneva.*

Ismail, E. &. (2012). Morpho-tectonic analysis of the Tekeze River and the Blue Nile drainage systems on the Northwestern Plateau, Ethiopia. *Journal of African Earth Sciences, , 69 (2012)*, 34–47. doi:DOI: 10.1016/j.jafrearsci.2012.04.005

Kasahun, T. (2012). *The Tourism Industry in Ethiopia.* Mekelle: University, Ethiopia.

Mesfin W.Mariam. (1972). *An Introductory Geography of Ethiopia.* Addis Ababa : Addis Ababa E.S.P. Press.

Ministry of Education. (2017). *Education Statistics Annual Abstract, 2015/16, Addis Ababa.* Addis Ababa.

Ministry of Education. (2017). *Ministry of Education (2017). Education Statistics Annual Abstract, 2015/16, Addis Ababa.* Addis Ababa.

Ministry of Mines. (2014). *The Federal Democratic Republic of Ethiopia Ministry Of Mines and World Bank Group. Strategic Assessment of the Ethiopian Mineral Sector Final Report.*

Ministry of Mines and Energy. (2015). *National report on mining.* Addis Ababa.

Ministry of Urban Development & Housing. (2015). *National Urban Development Spatial Plan, National Urban Systems Study - Final Report.* Lyon.: Egis International in association with IAU-IdF&Urba Lyon.

Mohr, P.A. (1960). *The Geology of Ethiopia.* Addis Abab: Addis Ababa University College Press.

Morgan, R. (2005). *Soil Erosion and Conservation.* Blackwell Publishing.

National Bank of Ethiopia. (2019). *Annual Report (2017/18).* Addis Ababa,Ethiopia.

NRMRD-MoA. (1998). *Agro-ecological zones of Ethiopia.* Addis Ababa: Natural resources management and regulation department of MOA.

Osman, K. T. (2014). *Soil Degradation, Conservation and Remedies.* Chittagong , Bangladesh: Springer.

Pausewang, a. S. (1990). *Ethiopia Rural Development Options.*

Tafesse, A . (2016). The Historic Route in Ethiopian Tourism Development. *African Journal of Hospitality, Tourism and Leisure, 5(2).*

Taye Mengistu, & Solomon Bellete. (1986). An overview of Ethiopia's Agricultural Production and Agricultural Policies. *Workshop on Food Strategies.* Alemaya .

Tegene Teka , & Tennassie Nicola. (1984). *Rural Poverty Alleviation in Ethiopia.*

UNIDO. (2018). *Industrial Park Development in Ethiopia Case Study Report.*

W., F. M. (2016). *Understanding Ethiopia: Geology and Scenery.* Switzerland: Springer International Publishing.

Weldesilassie, A. B. (2017). *Study on Industrial Park Development: Issues, Practices and Lessons for Ethiopia. EDRI Research Report 29.*

Young, J. (2012). *Ethiopian Protected Areas A 'Snapshot': A Reference Guide for Future Strategic Planning and Project Funding.*